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THE ENGINEER

A Seven-Day Journal

Sir Roy Fedden's Appointment

IT is announced by Leyland Motors, Ltd., of Leyland, Lancashire, that a new establishment is to be set up for long-term research and development. It will be entirely separate from the firm's existing research department, which will continue to be responsible for short-term projects. To lead this new enterprise the services of Sir A. H. Roy Fedden, D.Sc., F.R.Ae.S., M.I.Mech.E., have been secured. Sir Roy has been appointed to the Leyland Board, with the title of Director of Research and Development, with effect from January 1, 1949. Sir Roy's present headquarters are at the Leyland London Office, Hanover House, Hanover Square, W.1. It is also announced that Mr. H. S. Ford is assistant general manager of the firm as from January 1st. Mr. Ford is at present works manager of the Chorley branch works of Leyland Motors, Ltd., a position which he will continue to hold in addition to his new appointment.

The Water Resources of South Africa

FOLLOWING a suggestion made by the Colonial Office in 1945, Professor Frank Debenham, M.A., Professor of Geography at Cambridge University, paid a six months' tour to Northern Rhodesia, Nyasaland and the Bechuanaland Protectorate, in order to survey the water resources of those territories. His report, which has just been published for the Colonial Office by the Stationery Office, price 10s. 6d. net, describes in considerable detail the water resources of the Beehuanaland Protectorate, Northern Rhodesia, the Nyasaland Protectorate, Tanganyika Territory, Kenya and the Uganda Protectorate. In his general recommendations Professor Debenham stresses the great need for small schemes of conservation rather than large schemes, the construct onal work being preferably carried out by African native labour, thereby inculcating a sense of responsibility towards water supplies on the part of the African native authorities. For sandy or alluvial country a jet-drilling outfit in a mobile form is suggested. Jet drilling horizontally into water-bearing sands and alluvial banks is recommended and suggestions for the treatment of "sand" rivers are made in the text and in an appendix. The need for more data on water resources is very great, and efforts to increase such knowledge are being made. Small expeditions of junior engineering geology or geography students to make reconnaissance surveys of a hydrological type are suggested. Special problems occurring in connection with the Nyasaland, Northern Rhodesia and Kenya supply sources have been given priority and have received particular attention. Strong recommendations are made for establishing courses of training for Africans in the simpler constructions required for water development. The value of demonstration schemes in the treatment of water is stressed, provided that arrangements are made whereby Africans from other similar areas can see such demonstrations. This suggestion for water is analogous to what has already been done for agriculture.

A Trade Exhibition Advisory Committee

GOVERNMENT policy on trade exhibitions has been based, since the war, on the report of the Ramsden Committee, which studied the matter in 1945. The Board of Trade states, however, that doubt has been expressed in some quarters recently as to how far the validity of that committee's recommendations may have been affected by the trend of Britain's post-war economic circumstances. New projects for exhibitions in various forms are frequently put before the Board of Trade and the value of a standing committee of experienced business men to advise on such projects in the light of current conditions has been appreciated for some time. An Exhibitions Advisory Committee has, therefore, been set up under the chairmanship of Sir Guy Locock, a Vice-President of the Federation of British Industries, and though most of the members will serve in a personal capacity, the major industrial organisations have nominated representatives. It is hoped that the committee, as finally constituted, will afford a cross-section of those most closely concerned with and experienced in export problems. The committee's terms of reference are to advise the Board of Trade, in the light of the Ramsden Committee's report, on questions of official participation in or sponsoring of exhibitions and trade fairs, both in the United Kingdom and overseas, and on any general question of exhibition policy; to advise on proposals by industry or by other interests active in promoting exhibitions or trade fairs; and to make such suggestions to the Board of Trade as may seem desirable in order to promote and co-ordinate national action regarding exhibitions and trade fairs. The Board of Trade explains that it has been necessary to draw up the 1949 programme of official participation in trade fairs overseas without waiting for the new committee's views. The comment is added that, so far as overseas trade fairs are concerned, the number of pressing invitations increases rather than diminishes each year, and the choice has been a process of elimination.

Retirement of Mr. R. H. Collingham

IT is announced that Mr. R. H. Collingham, M.I.C.E., M.I. Mech. E., relinquished the position of chief turbine engineer for the British Thomson-Houston Company on December 31, 1948, but that he will continue his association with the Company as a consultant on technical design problems. Mr. Collingham, was born in Hull and was educated at Hymers College. He received his early technical training at Lincoln Technical College, whilst serving an apprenticeship with Robey and Co., of Lincoln. He joined B.T.H. Company in the test department in 1905, and was ultimately given charge of the turbine test section and made chief assistant to the head of the department. In 1908 he transferred to the turbine engineering department to found the section dealing with exhausters, blowers and compressors, and he was responsible for all the original designs for that class of machinery. Later he extended his activities to include all aspects of turbine design, and was appointed chief assistant to the late Mr. F. Samuelson, in 1925, and was appointed chief turbine engineer in 1939. He became an Associate Member of the Institution of Civil Engineers in 1907, and was elected a Member in 1924; in 1927 he was elected a Member of the Institution of Mechanical Engineers. The recent rapid development in B.T.H. design of all kinds of turbine machinery is due in large measure to Mr. Collingham's genius and enthusiasm for his work. One such notable example was the extra-high-temperature 10,000-kW turbo-alternator which was designed and built by B.T.H. Company for the Detroit Edison Company of U.S.A., and was installed in 1929. That turbine, operating at 1000 deg. Fah. inlet temperature, was an important advance on previous steam turbine practice, and it was the successful operation of that plant that led to that close association between Mr. Collingham and Air Commodore Sir Frank Whittle, K.C.B., which resulted in the practical development of the Whittle gas turbine jet engine. The B.T.H. Company built the first experimental jet engine in 1937 and—in 1941—the first jet engine, which, fitted in a Gloster aircraft, was successfully flown in May of that year for the first time. Consequent on the retirement of Mr. R. H. Collingham on December 31, 1948, Mr. K. R. Hopkirk, M.A., assistant chief mechanical engineer of the British Thomson-Houston Company, assumed responsibility for turbine and gearing design and engineering. Mr. P. D. Morris, A.M.I. Mech. E., was appointed chief turbine engineer and Mr. S. A. Couling, A.M.I.C.E., A.M.I. Mech. E., chief gear engineer.

Radio Tests on British Railways

ACCORDING to a recent announcement by British Railways, a series of tests is to be carried out with radio equipment to ascertain if this means of communication can be used to facilitate traffic or engineering operations. In addition to fixed radio stations the tests will also be made with transportable equipment on vehicles and portable wireless sets suitable for use by members of the staff engaged on working sites. The investigations are planned to determine the possible value of wireless for communication between shunting engine drivers, ground staff, and control towers in marshalling yards; communication between staff during extensive engineering operations, and communication from a central depot for road cartage collection and delivery vans. Tests are in hand using ultra-high-frequency to determine the possibility of providing radio communication through tunnels, to facilitate engineering operations in difficult locations. Radio is being used in a number of places on railways in the United States to good effect and, although the conditions in this country are somewhat different, the outcome of the tests will be awaited with some interest. We are informed that working trials will begin as soon as the radio equipment now on order becomes available.

R.M.S. "Caronia" at Southampton

ON Monday, January 3rd, by the invitation of Cunard White Star, Ltd., an inaugural luncheon took place on board the new R.M.S. "Caronia," before her departure on her maiden voyage to New York, via Cherbourg, on Tuesday, January 4th. The many guests had an opportunity of seeing the new colouring of the ship above the red boot topping in four shades of light green, which are most effectively blended, and merge gently into the palest shade used for the deck-houses. Great care was taken to test the durability of the new colours, which were exposed for long periods to sea atmospheres and to tropical weather. From the outset the new "Caronia" was specially designed to combine the two roles of a North Atlantic liner and a cruising vessel, and her size will enable her to enter all necessary ports. When cruising, all the passengers will be of one class and full use will be made of both the first-class and the cabin-class public rooms and cabins. For that reason two restaurants have been provided on the restaurant deck, with the appropriate royal names of "Balmoral" and "Sandringham," the kitchens and galley accommodation being conveniently arranged between them. In addition, meals can be served in the Veranda Café, and on deck when necessary, from numerous small pantries. Further reference to this fine ship is made elsewhere in to-day's issue.

The Navy of To-day and To-morrow

No. I

(By Our Naval Correspondent)

THE successive cuts in the personnel of the Armed Forces announced in 1947 made it very difficult for the Admiralty to get on with their plans for reorganising the Navy on a long-service peacetime basis. When, in October of that year, Naval personnel had to be further reduced to 147,000, (a cut of 17 per cent on the revised figures of 178,000 for 1947/48, fixed only two months previously), the Admiralty took a courageous decision. They decided to immobilise the greater part of the Navy so that the reductions could be achieved, and our naval strength built up again in the shortest possible time.

War is a continuation of policy, and no doubt the Fighting Services were told at the time that the possibility of war in the immediate future could be ruled out. Indeed, as Lord Chatfield pointed out in the House of Lords, the Board of Admiralty must have been informed that they could more or less lay up the Fleet for six months. Furthermore, they probably had in mind the Government's intimation that this reduction was likely to be final and should be regarded as our peacetime strength in naval personnel.

In the result, it has proved a most wise decision. A month or two ago, Commander Noble, an M.P., who speaks with authority on naval affairs, and is not backward in his criticism of the Government's naval policy, expressed the view that the Navy was now probably a year or two ahead of the other two services in planning and organisation. And the number of ships of the Home Fleet which left England in September last for a cruise to the West Indies and South African ports, though insignificant compared with the size of the Home Fleet in pre-war days, is a clear indication of the satisfactory progress made in the build-up of the Navy during 1948.

The main difficulty in commissioning ships for sea at the present time, however, is not lack of men, for the flow of long-service volunteers is now twice what it was before the war, but the lack of trained men to man them. Throughout six years of war, most of our personnel joined the Navy for hostilities only. Moreover, each year from 1939 onwards, numbers of pre-war long-service personnel who were in the Navy for seven, twelve, or twenty-one years, became time-expired, and due for discharge at the end of the war. Thus, we have lost since the war a number of officers and a very high percentage of petty officers and men. Until the replacements have been trained in the complicated weapons and instruments now used in a man-of-war, which is not to be done in a day, we cannot expect to have a large number of vessels in commission with efficient and ready-for-war ships' companies.

What of our material strength ? Have we enough ships and are they of the right kind ? The results of development and research take a long time to study and to apply in the form of improved material, and there is no reason to assume that any foreseeable enemy has gone ahead faster in this respect than we have. It can therefore be said with confidence that if war came to-morrow, we would be in a position to give a good account of ourselves at sea. For we still have plenty of effective ships left over from the war, and a vast reserve of trained men now in industry available, after a period of chaos in the early stages of mobilisation, to man them.

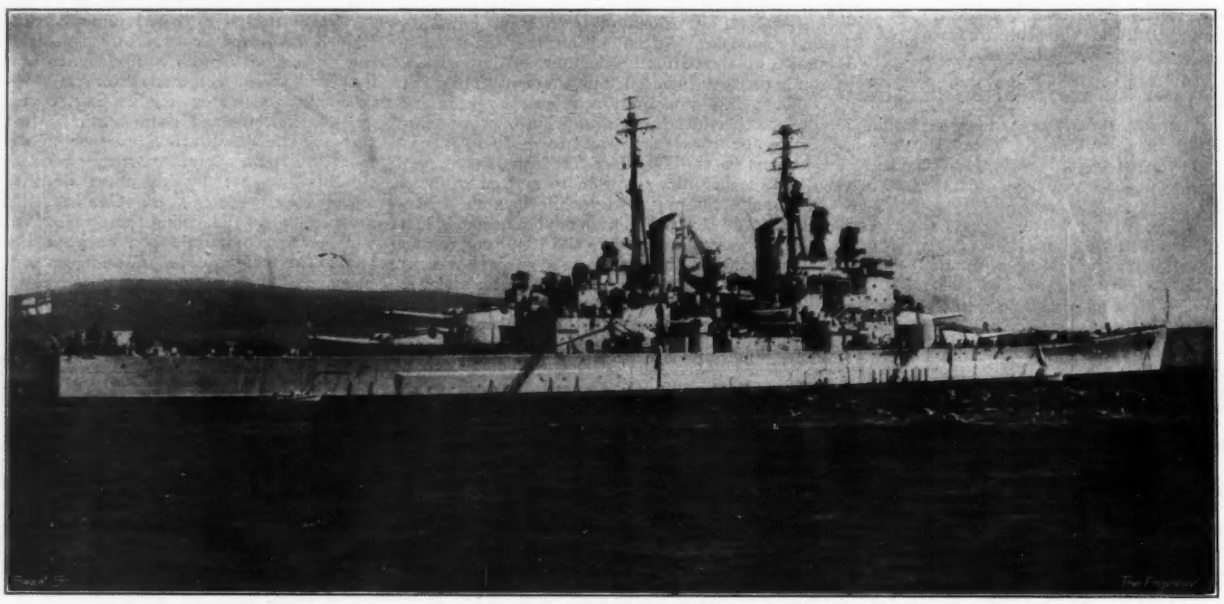
But it is war in three, five or ten years' time that is the real danger. With each year that passes, warships become less fitted to perform their proper function in war, and large ships take a long time to build. A programme of new construction should not therefore be delayed much longer. What the size and nature of the programmes are to be can only be known to the Board of Admiralty. It is, however, possible for the technically-minded student of sea warfare to discuss profitably the considerations which must influence their Lordships in reaching a decision with special reference to the atomic charge on naval warfare and to the future of the battleship, the aircraft carrier, and the submarine. It is these types of vessels which are likely to embody the most striking of the developments during and since the war.

The Effect of the Atom Bomb on Naval Warfare

Probably only an inner circle of scientists are in a position to say whether atomic charges can, at the present time, be embodied in a missile fired from a gun, or a rocket platform, or inserted in the warhead of a torpedo. Developments of this kind, however, must be anticipated and allowed for when calculating our naval offensive and defensive requirements. Fortunately, the published results of the atomic bomb tests, carried out at Bikini, provided valuable information, not only for the designers of warships, but also for senior officers and others responsible for the conduct of war at sea.

There was no need for tests to prove that in its present form the atomic charge has greatly increased the importance and value of the naval air arm. In principle, the atomic bomb is merely a better bomb, vastly more effective in its results than the largest bomb hitherto dropped from an aircraft. To the increased range of a naval aircraft given by the carrier is now, therefore, added the greatly increased destructive power of the bomb it can carry. Also, as the most effective counter to the atom bomb is to intercept and shoot down the aircraft conveying it, carrier borne aircraft are alone capable of extending geographically the area in which such interception will be practicable.

The real value of the Bikini tests lies in the evidence they provided that, from the defensive aspect, the Navy should be less affected by the atomic bomb than either of the other two fighting services in carrying out the tasks allotted to them. The best way of reducing the amount of damage done by an explosion is dispersion, a principle which was very definitely confirmed at Bikini. In both the above-water and underwater explosions, ships more than a mile away suffered little or no damage, either to material or to exposed "personnel." Tactical formations of warships and convoys



H.M. BATTLESHIP "VANGUARD"

must therefore be changed so that ships can cruise a mile apart (or more if the atomic charge is increased) instead of in close order, two or three cables apart, as they do at the present day. The vastness of the oceans should make this perfectly feasible, except in focal areas, though it may well mean a large addition to the number of anti-submarine escorting vessels hitherto required, in view of the possible need to provide close escorts for single ships.

All this does not mean that ships will not be sunk by the atomic bomb, but it does mean that the number of ships sunk or placed out of action by one atom bomb will be reduced probably to one (in addition to such lesser vessels as may be in close escort). Even in the recent war, large and important ships—such as the "Prince of Wales," "Barham" and "Renown,"—were sunk by bomb or torpedo, but the Navy was still able to get on with its job.

The Bikini tests also proved the necessity for the strengthening of the ships' hulls, the redesigning and strengthening of superstructures and the protection of personnel from radio activity, blast and flash, to reduce the extensive damage to material and personnel from "near misses." This applies to all "near misses," whether the missile is a bomb, magnetic torpedo, mine or shell. Here, again, the U.S. Navy Department and our Board of Admiralty alone have the necessary knowledge and data to decide on the changes of design which are required. But the fact that they are required and may entail a considerable amount of reconstruction emphasises the wisdom of the Admiralty policy of "hastening slowly" with the ships laid down during the war, which they have decided to complete.

Finally, there is the question of bases, which, it is argued, will be obliterated by the atom bomb. The protection of fleet bases in our homeland is not, fundamentally, a naval responsibility. Reliance must be placed on the Government's measures for civil defence and on a heavy R.A.F. bomber offensive. But in carrying out an offensive operation overseas, a naval task force can now be independent of shore bases as a result of the development of the Fleet Train, details of which have already been given in this journal, for supplying oil, stores, ammunition and equipment to, and repairing and refitting, warships at sea.

The Battleship of To-day and To-morrow

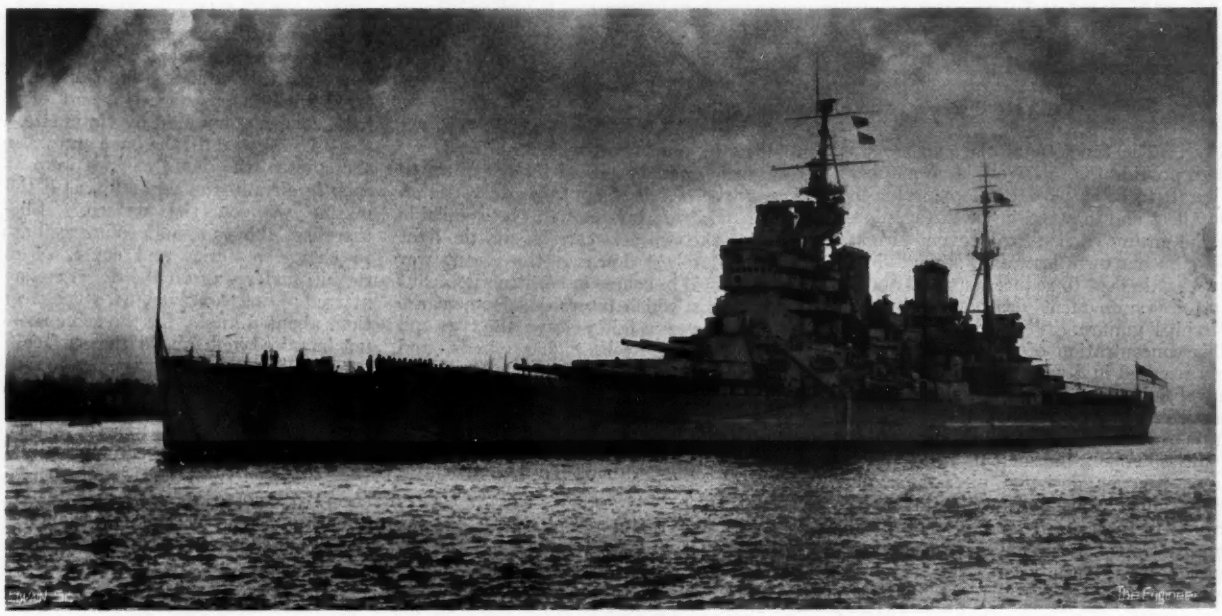
With the consignment to the scrap heap early in 1948 of the remainder of our pre-war battleships and battlecruisers fit for active service, we are left with only the "Vanguard" and the four "King George V" class. High ranking naval officers have expressed the view that the 42,500-ton "Vanguard" will possibly be our last battleship. The basis of this prophecy seems to be the definition of a battleship embodied in the peace treaty with Italy: a war vessel, not an aircraft carrier, with a standard displacement exceeding 10,000 tons, or which carries a gun of over 8in calibre. This, of course, is the old Washington Treaty definition of a capital ship, drawn up at a time when the principal naval powers were about to build 10,000-ton cruisers with 8in guns. It is certainly not conducive to clear thinking.

A battleship is much more accurately described as a war vessel which is able successfully to engage an opponent capable of developing an equal volume of fire (not necessarily gun) power, and which, subject to that overriding requirement, has the maximum possible anti-aircraft armament and protection against air and underwater attack. It is obvious, therefore, that if Britain is to build another battleship, the vessel will not necessarily be another "Vanguard." She may, indeed, be unlike any ship hitherto visualised, for her characteristics must depend on the size and armament of the ship required to develop a volume of fire-power equal to or greater than that which can be developed by any war vessel, which a foreseeable enemy may build. In that connection, the Americans are already experimenting with a main armament of rockets in two of their uncompleted battleships laid down during the war.

Why, it may be asked, would any naval power require such a vessel, when it would seem from operations in the Pacific in the recent war, that decisive battles are fought out by aircraft carriers from afar? This, however, is, unfortunately, only half a truth, for there are such conditions as fog and darkness, which very considerably hamper aircraft operations. And if our enemy possesses battleships, he may well choose these conditions to fight a decisive battle or, alternatively, to attack the aircraft carrier herself. An aircraft carrier which has to accommodate, and fly off and on, large numbers of aircraft can never be as powerful offensively and defensively as a vessel of equal size which does not have to do these things. She herself, therefore, requires protection, particularly under conditions when her aircraft cannot operate effectively. It is worth noting also, in passing, that when operating within range of Japanese land-based aircraft, the U.S. carriers found it invaluable to have the close support of battleships, with their heavy, reliable and efficient anti-aircraft armament, and more substantial protection against damage from bombing attacks.

No foreseeable enemy at the present time possesses even one battleship worthy of the name, and our five modern battleships should, therefore, be sufficient for any operation to be undertaken by a British Naval Task Force in a war in the near future. Incidentally, it is very desirable that this American term, "Task Force," should be adopted in the British Navy. For the composition of the force to be employed in any operation is then fixed, not by the desirability of having a "balanced fleet," but by what that force has to do, whether it is to meet submarine attack, form cover for a convoy against a powerful raider known to be at sea, or attack military objectives ashore in the face of land-based aircraft.

It is, however, clear that whether the "Vanguard" and her consorts should be added to, or replaced in due course, must depend on the considerations outlined above and not on any prophecy lacking the basis of no logical argument or clear thinking.



H.M. "King George V" Class Battleship "Duke of York"

The Aircraft Carrier of To-day and To-morrow

The R.A.F. has been criticised for concentrating so much thought before the war on the strategical bombing offensive—the bombing of the enemy's industrial establishments

behind the front line—and paying too little attention to the defence of ocean trade routes or to air co-operation with the Army, which formed such a marked feature of the German offensive in the early stages of the war.

However, if the R.A.F. is to be criticised on these grounds, the Navy is certainly no less open to criticism for training and developing its Naval Air Arm on the assumption that a fleet action was the main purpose

H.M. LIGHT FLEET CARRIER "THESEUS"

in view. The function of the carriers was thus to provide the relatively large numbers of aircraft to be employed in looking for the enemy fleet and in attacking with torpedoes, first the enemy carriers, to prevent aircraft attacks on our own fleet, and, secondly, the enemy battle fleet to reduce its speed and so ensure its subsequent destruction by our battleships' gunfire.

This concentration of thought on a fleet action resulted in a very restricted provision of naval fighters and made little demand for high performance from the fighters and other aircraft provided. Nor were there any serious difficulties in operating such aircraft from the 30-knot pre-war designed aircraft carrier. Combined operations, however, in the Pacific, in which large seaborne forces were within range of strong land-based enemy bombers, required carrier-borne aircraft of high performance. There seems no doubt that the performance of naval aircraft must increase concurrently with that of land-based aircraft. In the future, offensive operations in distant enemy waters—whether it be to land troops or to bomb rocket sites or other military objectives—seem likely to become the rule rather than the exception.

The ever-increasing weight of aircraft is one of the main problems—made still more difficult by the introduction of the twin-engine type—which have to be overcome in the carrier. Apart from the "Eagle" and "Ark Royal," now under construction, all our six fleet carriers are of pre-war design. Their speed of 30½ knots is just sufficient for the take-off of the twin-engine Sea Mosquito fighter under normal conditions of wind. The six light fleet carriers now in service in the Royal Navy are a development of the early war years. They are smaller than the fleet carrier—14,000 tons, as compared with 23,000—and some 5 or 6 knots slower, but the actual length of the deck space available for landing is approximately the same in both classes. In the light fleet carriers, however, even the modern single-engine fighter has to be assisted by the rocket-assisted take-off gear when flying off in light winds.

Much the same difficulties arise with landing-on, though developments in under-carriageless aircraft and the tricycle under-carriage may reduce them to some extent. The acceptance of the jet-propelled "Vampire" for carrier work has indeed been made possible by this latter innovation.

Another problem is the type of flying deck. Is it to be heavily armoured to deal with the suicide aeroplane, or the bomb which explodes on impact, thus introducing further problems in connection with stability? Or is the armour to be placed further down to protect the vitals from the delay-action bomb? Little information is available regarding the two fleet carriers and the light fleet carriers laid down in the recent war years and still in course of construction. But the directions which future development are likely to take seem fairly clear; the type and length of flying deck, higher speeds, and improved methods of assisting take-off and arresting landings, to enable carriers to operate the heavier, higher-performance aircraft of the future.

The Submarine of To-day and To-morrow

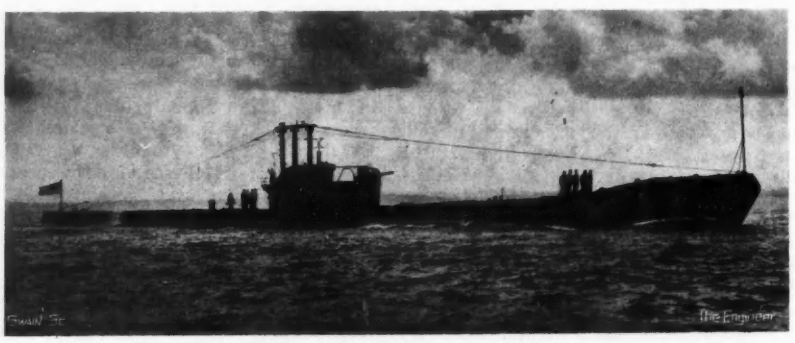
In no aspect of the recent war at sea was the struggle for mastery between the offensive and defensive more intense and more continuous than in submarine and anti-submarine operations.

In the Eastern Atlantic the U-boats found it more profitable, in the face of our Asdic detection devices and land-based aircraft patrols, to concentrate on the surface at night in "packs," in the vicinity of a convoy and to attack on the surface, radar being used in lieu of the periscope for aiming their torpedoes. But improved radar facilities and anti-submarine weapons enabled us to spot the U-boats on the surface and either to sink them or to force them to submerge. This compelled them to move further out into the middle of the Atlantic, out of range of land-based aircraft, where they could remain on the surface by day diving only when the convoy was sighted and again carrying out the old and recognised form of submerged attack with the periscope.

Some sort of counter to this was provided by those courageous pilots who were catapulted from merchant ships to carry out an air patrol until their petrol was exhausted. They then had to land on the sea and be picked up if possible. But the real answer came with the escort carrier, which accompanied the convoy throughout the whole voyage and enabled continuous aircraft patrols to be maintained.

One of the disadvantages of the submarine has always been that she was obliged to come to the surface at night to charge her batteries. No one, indeed, who has not been on a submarine patrol in wartime can fully realise the feeling of insecurity there is in a submarine when on the surface in hostile waters, and when the night is pitch black. And the U-boats in the Atlantic began to find it very dangerous to surface at night—they were so often spotted by radar. To overcome this difficulty the Germans countered with the schnorkel, a sort of hinged hollow tube, about 10in by 4in in size. With the tube raised until the open end was above the surface, the diesel engines were able to suck in air and run normally, as if the submarine was on the surface. She was therefore, able to remain submerged at night to charge batteries and could, of course, remain under way on the diesel engine submerged; not, however, at a speed greater than about 6 knots, for the schnorkel could not be raised high above the surface, without itself becaming a target for the radar.

It soon became a practice for the U-boats to submerge after they had left harbour and reached the North Sea, to raise their schnorkels and remain submerged practically for the whole voyage. With the U-boat proceeding at about 6 knots the schnorkel made little "feather" to be seen by day, though doubtless, when she was in areas likely to be clear of Allied ships or aircraft, it was raised high enough out of the water to enable her to proceed at higher speeds, particularly in the dark hours.



SCHNORKEL-EQUIPPED SUBMARINE H.M.S. "ASTUTE"

Research and development will obviously now be concentrated on improving the speed of a submarine when submerged. The submarine's greatest asset is her ability to conceal herself by submerging, but hitherto she has only been able to do so by a very

great sacrifice in speed. For propulsion, when fully submerged, is achieved by electric motors fed by the lead plate and sulphuric acid batteries, which, with a weight of battery in proportion to the weight of the rest of the equipment required, will still only give a maximum speed of about 10 knots. Even this speed is only possible for a brief time, notwithstanding the increase in battery capacity in recent years.

The non-expert will readily understand the importance of high submerged speed if he imagines himself running at 7 miles an hour along a road which stretches to a junction at crossroads. If he is to intercept a motor-car proceeding at 25 m.p.h. towards the same junction along another road at right angles, he can only do so if, when he first sees the motor-car, he himself is very much closer to the junction. Many a ship has been sighted by a submarine under similar conditions, perhaps 15 miles away, and has escaped attack because the submarine was not fast enough to intercept her.

A schnorkel is of little assistance under these conditions, for the " feather " would be enormous at high speed and easily seen from a surface ship or aircraft, apart from the radar aspect. Indeed, during the final stage of an attack the submarine has to reduce speed to dead slow on her motors before raising her periscope to take an occasional observation of the position and course of the target ship. Though it may well be that with developments in Asdic it may become possible to take reliable bearings of the target by Asdic and so remove the necessity for raising the periscope at all during the final stage of the attack.

High speed submerged is therefore required by a submarine during the early stages of an attack, and for a considerable time, in fact. For the presence of a target many miles distant may be reported to her by another submarine, and she may be forced to submerge a long distance away from the target owing to the presence of aircraft. But high submerged speed is also required for yet another and equally important reason—to get away from anti-submarine vessels. It needs no expert to appreciate what a serious problem it will be for the anti-submarine offensive if a submerged submarine can only be hunted by a vessel which has the speed of a destroyer or something like it.

In a word, then, the aim will be to change the submarine from a surface vessel which has the power to submerge, as she is at the present time, into a real submarine; that is to say, a vessel which normally navigates and remains fully submerged. It is likely to be a considerable time yet before this stage is reached, but the hydrogen peroxide engine goes some way towards it. Some details of this type of engine, which dispenses with the use of air, have appeared in an American technical journal, and it is reported that it is now being fitted in two U.S. submarines. There is, however, very little reliable information about the engine available, and it seems possible, in any event, that difficulties of fuel supply will, for the present, place a marked limit to its endurance.

No one outside the Admiralty or the U.S. Navy Department can possibly suggest a worthwhile answer to the question: what kind of vessel is the submarine of the future to be? For the moment, at any rate, it would appear that a diesel engine will still be necessary for making a passage and for cruising. And unless the necessity for taking periscope observations in the last stages of an attack is entirely eliminated, a submarine will also still require a storage battery and electric motors for very low submerged speeds, apart from electricity requirements for lighting and auxiliary motors. But from what has been said above it is not surprising that the Admiralty should be watching developments at the present time and that Navy Estimates for 1948–49 should show no submarines under construction.

(To be continued)

Labour in 1948

By GERTRUDE WILLIAMS*

No. I

THE year that has just ended may well come to be looked upon in the future as the turning point in post-war reconstruction, for it shows the first serious attempts on the part of the community to face the harsh realities of the economic situation. There must be very few people in the country now who do not know that we are living far beyond our present means and that our standard of living, austere as it undoubtedly is, could not be maintained without Marshall Aid. The export drive now figures so largely in general conversation that even the music hall comedian includes it in his topical patter and, though most of us are pretty adept at dismissing unpleasant truths from our minds, there has begun to be a fairly wide acceptance of the fact that we must increase productivity very much in the next few years unless we are prepared to live in an even more poverty-stricken way in the future than we are doing now.

Personal Incomes, Costs and Prices

The tone of the year was set by the publication, in February, of the White Paper on Personal Incomes, Costs and Prices, in which the Government issued a warning of the dangers that would be inevitable if inflation were allowed to continue to develop. The main argument of the White Paper was that the rise in prices in non-subsidised goods and services was due to an acute shortage, which could only be accentuated by increases in wages, salaries and profits and that the remedy must be sought in a great increase in production. Experience has shown that wages never manage to keep pace with prices when an inflationary race sets in; the only effect of such a contest is to bring immense suffering on those whose incomes are fixed or sticky, without any compensating gain to those whose incomes are more flexible. When goods are not available, no amount of push to raise wage and salary rates can enable people to get what does not exist; all it can accomplish is to enable those who are in a particularly favourable position to push their own claims at the expense of their less happily situated fellows. At the present time, it was pointed out, the effect of such sectional gains would distort the economy and prove disastrous for two important reasons: (1) it would result in such an increase in the prices of our goods on the world markets as to make it impossible to buy the essential imports needed for our recovery, and (2) it would continue to draw workers away from the essential export industries, whose selling prices must face the blast of world competition, to the more sheltered industries producing for the home market. The Government felt, therefore, that there could be no justification for any general increase in individual money incomes and it announced, consequently, that increased costs of production due to unjustified rises in wage and salary rates would not be taken into account in settling controlled prices or margins or other financial matters requiring Government action.

That did not mean that all rates of pay were to be frozen at the level at which they happened to be at the moment of the issue of this White Paper. It was recognised that there might be instances in which increases might be justified from a national point of view; for example, where it was clear that only such a rise would attract new recruits to an industry which was seriously undermanned. But it emphasised the belief that each claim for a rise must be considered on its national merits and not on the basis of maintaining a former relativity between different occupations and industries.

The great importance of this statement lies in the fact that it is the first attempt to provide any national guidance in the settlement of wage bargains. There have been many people who have criticised it for not going far enough and a good deal has been said of the need for a National Wages Policy of a more positive type; but it is doubtful whether all those who are loudest in their demands for such a policy are quite clear in their minds about its meaning and implications.

Wages and Collective Bargaining

The right to establish contracts freely as a result of collective bargaining between representatives of the parties concerned has been fought for and maintained for the last 150 years. This democratic principle has been considered so valuable that even in those industries where neither employers nor workers are sufficiently organised to be able to negotiate agreements which would be kept by the whole trade, the statutory machinery which has been established for this purpose deliberately copies as closely as possible the form of the independent, voluntary negotiating bodies. The only important differences between statutory and voluntary machinery for settling wage rates are those which derive from the lack of experience of the parties to the negotiations in the unorganised industries and the problem of ensuring that agreements are kept when workers have no trade union to which to report breaches of observance.

In well organised industries, with a long tradition of negotiation, the terms of agreement are loyally kept, although they are not legally binding and the members of employers' associations and trade unions can act, in a sense, as their own inspectorate. Where there is no experience of negotiation and few employers or workers are members of representative organisations some substitute for this informal method of making and maintaining agreements has to be instituted. But although the orders made under the Wages Councils Act or the Catering Wages Act have the force of law and are administered by a Government inspectorate, the terms are agreed by boards which represent as fully as possible both sides of the

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industry and the independent members are there only to prevent a possible deadlock. What seems at a superficial glance to be machinery for the fixing of wages by law turns out, on further inspection, to be the establishment of statutory provision for collective bargaining.

Indeed, so strong is the belief in the value of free negotiation of wages by the parties chiefly concerned, that the Minister of Labour and National Service was persuaded to withdraw a circular he had sent to wages boards and councils, drawing their attention to the contents of the White Paper, in which it was felt that he had sought too much authority over their deliberations, and to modify it in terms which emphasised the principle that such bodies have the responsibility for determining the conditions of employment in their industries, in the same way as that enjoyed by voluntary joint, negotiating machinery in industries outside the scope of the Wages Councils Act and similar legislation.

What alternative to such freely negotiated agreements is, in fact, possible in a community which sets such store on an appreciable degree of individual liberty ? How could the Government assess the relative payment for different types of work which would attract and retain all the various grades of workers where they are wanted ? The truth is that we still know very little about the drawing power of wages. Wages are, of course, a price and changes in price always influence the readiness of people both to sell and to buy the commodity to which they refer. But there is no doubt that there are many more factors that affect the relative attractiveness of occupations than we used to believe, and wages, nowadays, play a much less dominant role than they used to. It is not only that the dirt, danger and discomfort of certain jobs act as a deterrent to some industries ; often enough it is merely their unpleasant reputation that discourages workers from joining them, on the principle of " give a dog a bad name," even though, in fact, their conditions may have been so improved as to be little different from other types of work that have no difficulty in attracting adequate labour supplies. Sometimes all the imponderables that build up social prestige play a deciding part. The work of an air hostess on a short journey is not markedly different from that of a parlour-maid, but its social rating is very different, so that there is a waiting list of applicants eager to do the former and very few willing to undertake the latter. Sometimes it is the inconvenience of shift-working or the lack of suitable housing in the district that discourages workers from one trade ; and the amenities of another locality with clean streets, good shopping and recreational facilities and so on that attracts them to another. How could we pretend to measure the money value of these various factors in order to establish relative wage rates that would attract the required numbers into each kind of job ? In this positive sense a national wages policy is nonsense unless we are also prepared to conscript the whole working population, and push them about where we want them like a lot of robots.

This does not mean that all national guidance is unnecessary or ineffective. On the contrary. The value of the White Paper was that it focused attention on the most important element in the present wage situation—that a rise in money wages is worthless to the wage earner unless there are also more goods to buy with the money. Whilst leaving wages to be negotiated as usual, it insisted that due consideration be given to the fact that standards of living cannot be raised by a bigger pay packet but only by an increase in production ; and thus placed fully and squarely on the shoulders of the negotiators the responsibility for preventing any general rise in wages.

Wages and Profits

There has been a good deal of misconception about the objectives of the White Paper policy, for which Government spokesmen are partly to blame. The Trades Union Congress rather reluctantly supported the policy, but made the conditions that profits should be included in the embargo on increases and that the Government should use its influence to reduce prices. The first of these conditions is a natural and understandable demand. It would be unjust if the wage earners were the only section to be called on to make a self-denying ordinance, but the second is different in nature. If prices were reduced, real wages would rise and those spending them would be consuming an even larger amount than before. As the shortage of goods, with its corollary of high prices, was the reason for the attempt to prevent wage increases, it would be absurd to couple it with an actual expansion in consumption, even though the maintenance of prices at a high level with stationary wages would undoubtedly result in a fall in the standard of living. In fact, this temporary fall in the standard of living was exactly the situation that had to be faced. It all comes back to the elementary principle that you cannot consume goods and services that have not been produced or that you have to cut your coat according to the cloth.

In practice, some increases in wages have had to be allowed, even where they could not be justified on the conditions set forth in the White Paper. Some industries were already carrying on negotiations that were nearing completion and where employers had practically agreed to a rise in rates it was asking too much of human nature to expect the union leaders to withdraw their demands. It came soon to be accepted that negotiations which had begun before the publication of the White Paper would not be too strictly bound by its principles, but it was difficult to maintain even this as a firm dividing line, and the findings of the court of enquiry into the engineering dispute, for example, definitely deviated from it.

In this case, the unions, in putting forward a claim for a considerable rise in wages, argued that they had been waiting for two years for the employers' decisions on their proposals for a new wage structure, which contained suggestions for wage scales very much in line with those made in this wage claim, and that as soon as they had heard that the employers were unwilling to continue the discussions they had given notice that they would make a direct wage application. In these circumstances, they insisted, their claim should be considered as coming within the exceptions allowed by the White Paper, particularly in view of the rise in the cost of living during the two years that had elapsed since the proposals were first put forward. In their report (published at the end of August) the court said that, if the claim were to be judged solely by White Paper standards, they would find it difficult to justify any part of it ; but in view of the fact that the present claim was, in a sense, a continuation of negotiations that had been going on for some time, they felt that they might take into consideration the argument that the rise might have been gained before the publication of the White Paper. Although they could not agree to the basic rise of 13s. a week which the unions had asked for, they decided on a traditional British compromise of 5s. as a flat rate of increase. No reasons for this decision were given but it is possible that the court was influenced by the astonishing fact that the Treasury had already agreed to raise the wages of engineers employed in Government establishments, despite the principles which the Government had itself laid down, and that a refusal to make any concession at all would have led to such widespread industrial unrest as to have a serious effect on general output. Even as it was, the small increase fell so far below the unions' demands that, for some time, it was doubtful if they would accept it.

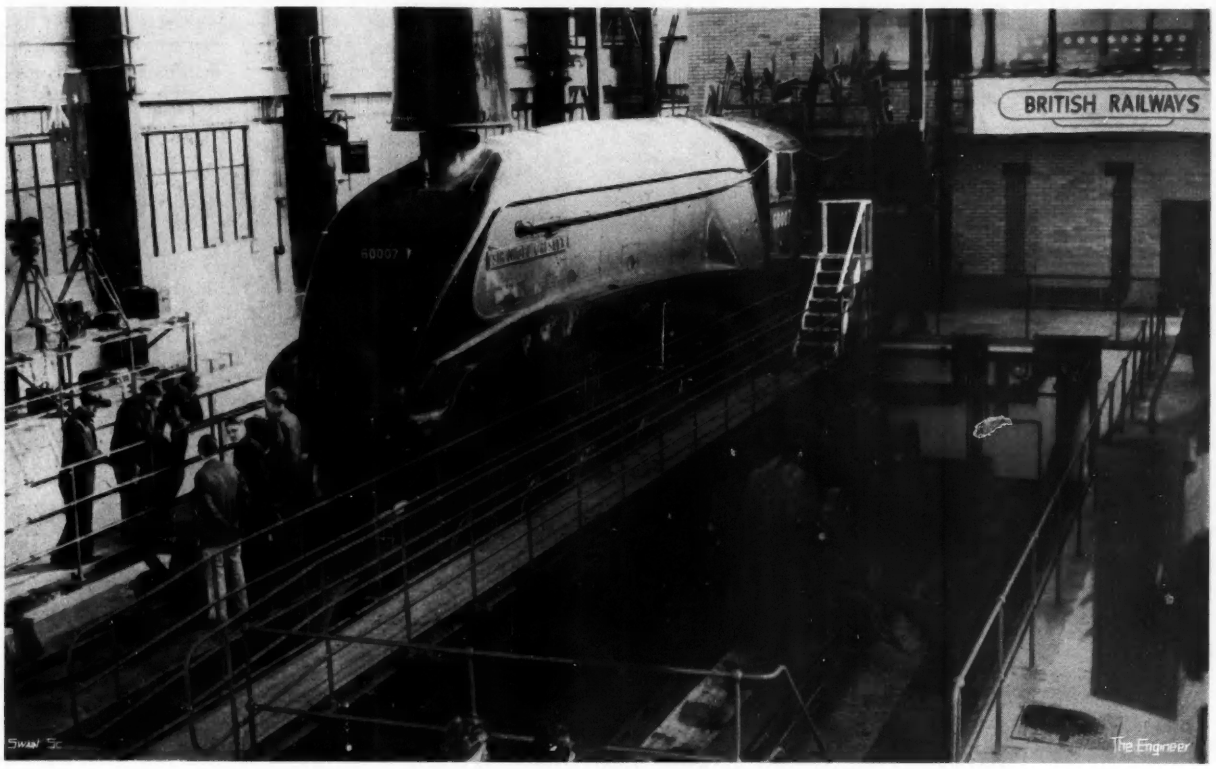
This deviation from White Paper principles has certainly had repercussions in other sections of industry and both the railway and the agricultural workers have put forward claims for substantial increases. Yet, looking back over the year, one cannot but be struck by the marked success that has, on the whole, been achieved in checking an inflationary rise in wages, the more so as it has placed on the trade unions the responsibility for carrying out a policy which is completely opposed to their traditional outlook. In the past the unions have rightly considered it to be their chief duty to try to raise the pay of their members whenever the opportunity seemed favourable, and such an acute shortage of labour as has been experienced since the war provides the ideal situation for an aggressive wages policy. In these circumstances the surprise is not that increases have taken place in some industries, but that, on the whole, the rises have been so moderate.

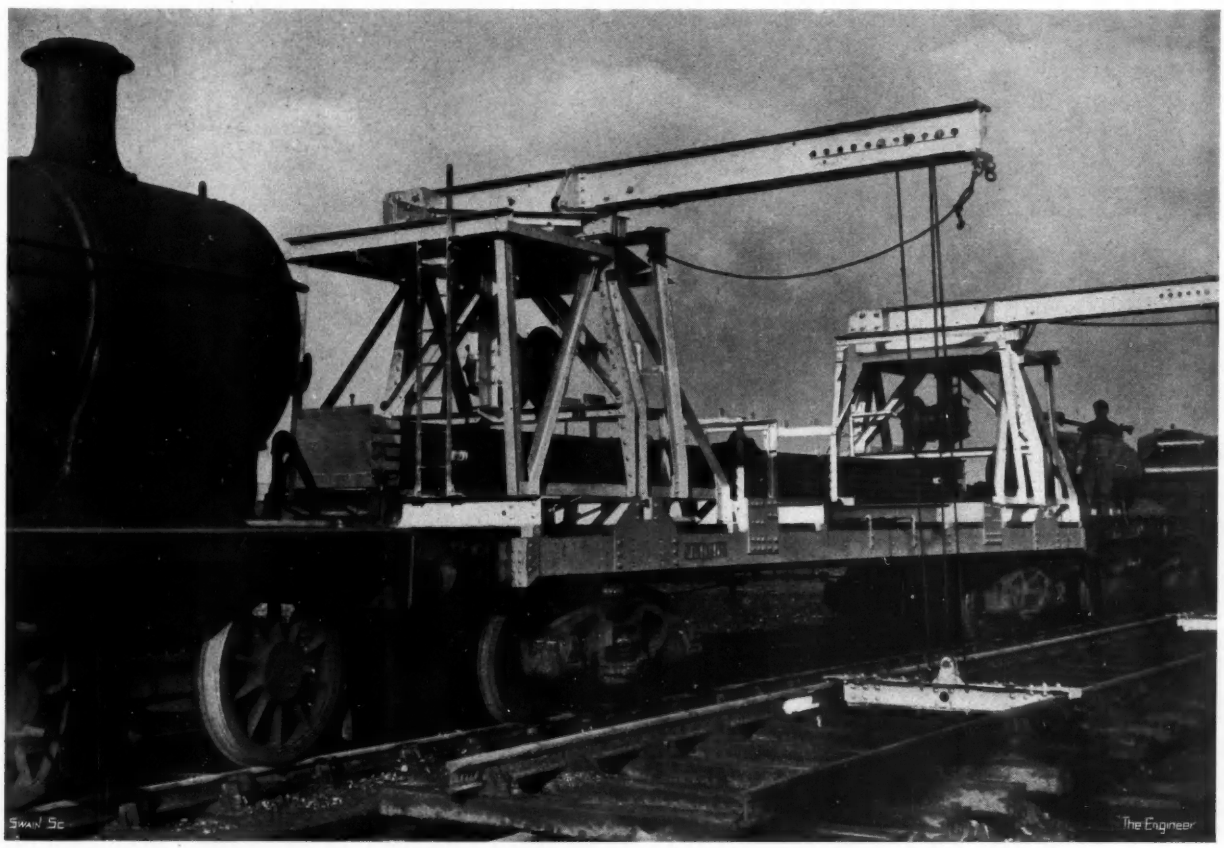
Trade Union Policy

This is only one illustration of a shift in trade union policy which may prove to be the outstanding feature of the year so far as the labour situation is concerned. " The fundamental purpose of the trade union," wrote Sidney and Beatrice Webb, in their classic work, " The History of Trade Unionism," " is the protection of the standard of life—that is to say, the organised resistance to any innovation likely to tend to the degradation of the wage-earners as a class." In the world in which trade unionism grew up this could be interpreted in only one way—as a grim fight on the part of each union to protect the interests of its own members. For almost a century trade unions were fighting to establish the right to exist at all, for it was not until the beginning of this century that the general body of the non-wage-earning community came to accept these associations as an integral and valuable part of our social organisation. To the fiercely individualistic employer of the nineteenth century, the demand of the trade unions to bargain collectively on behalf of his employees seemed a gross infringement of his privileges and authority, and the gradual expansion of trade union power was achieved in the teeth of bitter opposition. Nowadays, it is so widely accepted that industrial adjustments are made more smoothly, if both sides are organised to make agreements that are binding on all, that it is difficult to remember how recent is the change in attitude and that the earlier trade unions had reason to think of employers as enemies to be outmanœuvred rather than as allies in a common enterprise.

The Jesuits used to say that they were content if they could train a child until it was seven years old and modern psychologists have confirmed their belief that the years of early childhood are the most formative of one's whole life. In this respect an institution is not so very different from a human being and its early experiences

BRITISH RAILWAY ACTIVITIES IN 1948

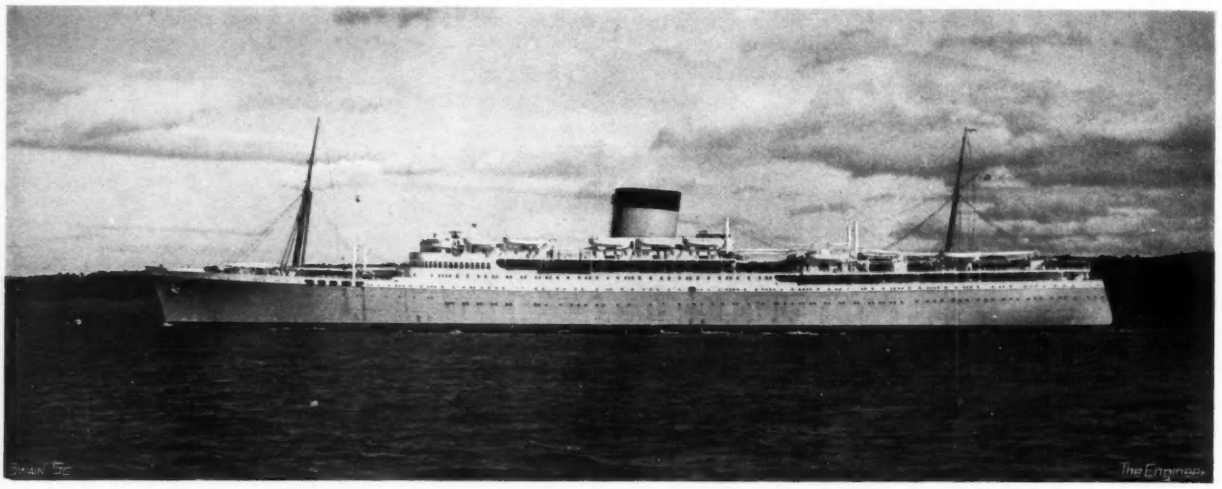


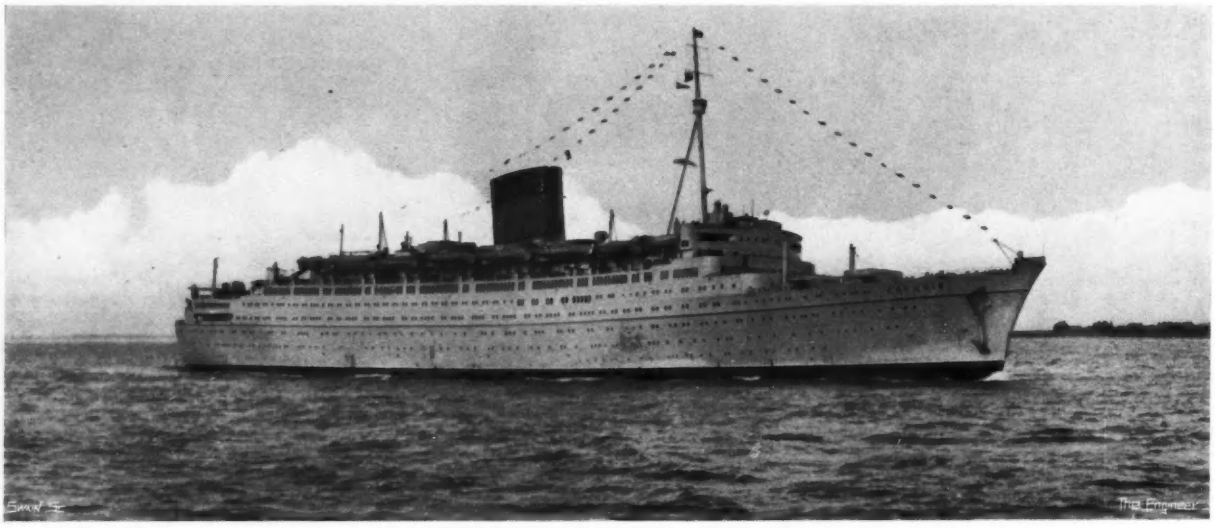


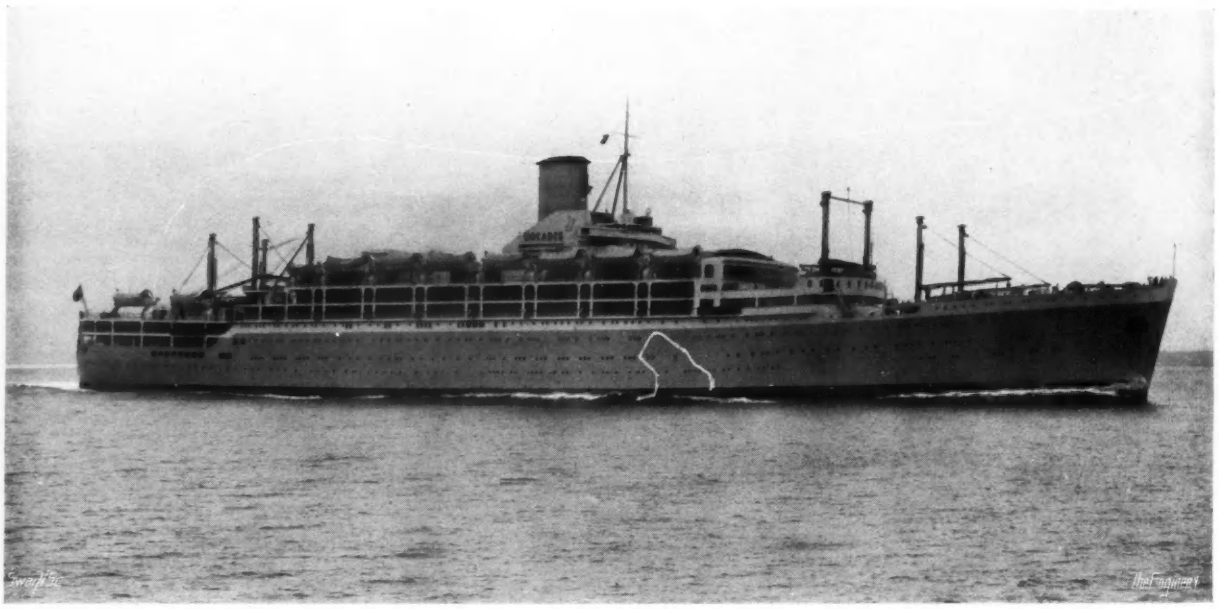
Locomotive on Test Bench at Rugby

Southern Region Track Laying Machine at Work

SOME LINERS OF 1948

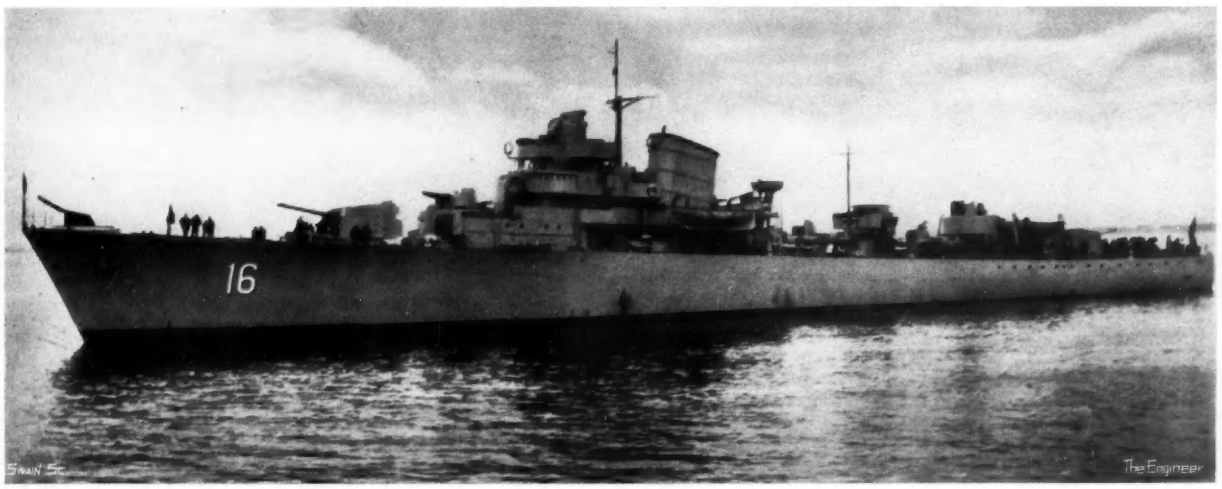


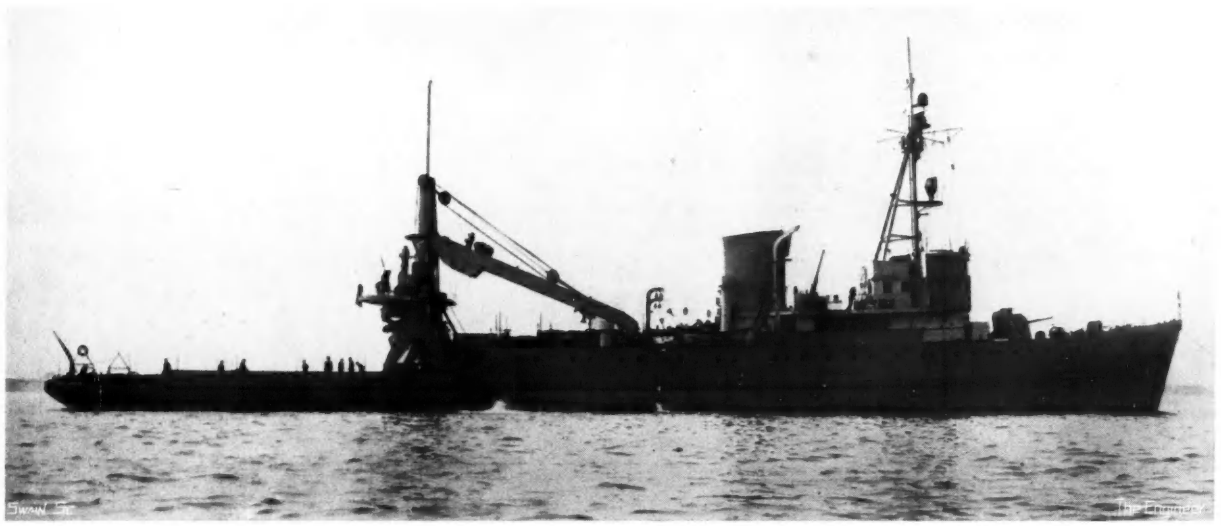


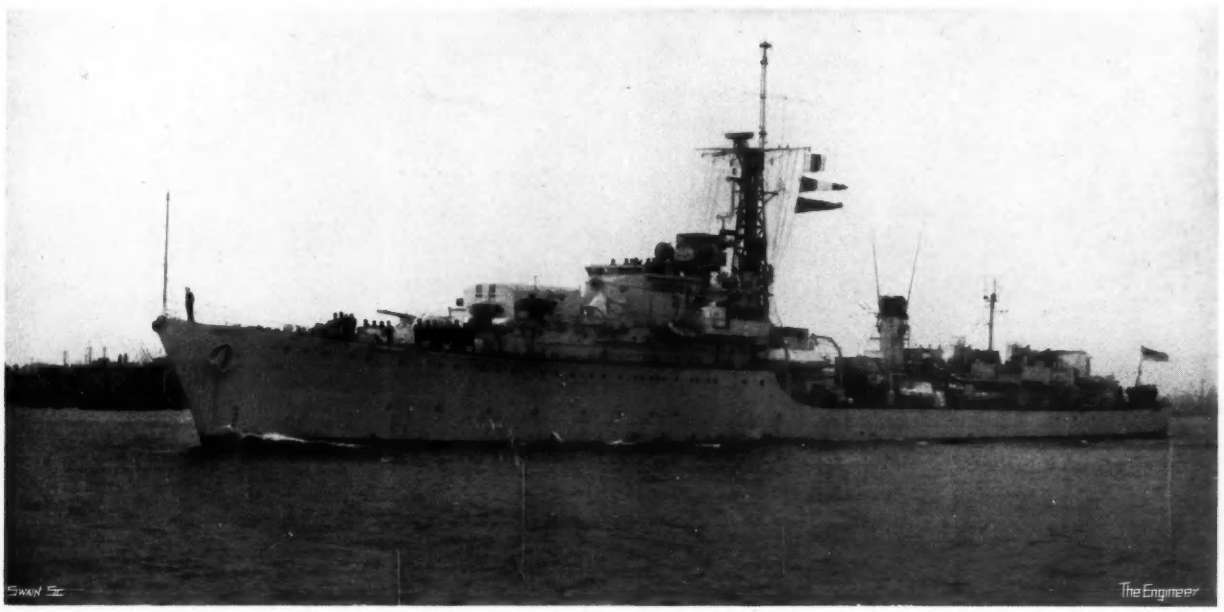


UNION CASTLE LINER "PRETORIA CASTLE"
CUNARD WHITE STAR LINER "CARONIA"
ORIENT LINER "ORCADES"

SOME NAVAL SHIPS OF 1948

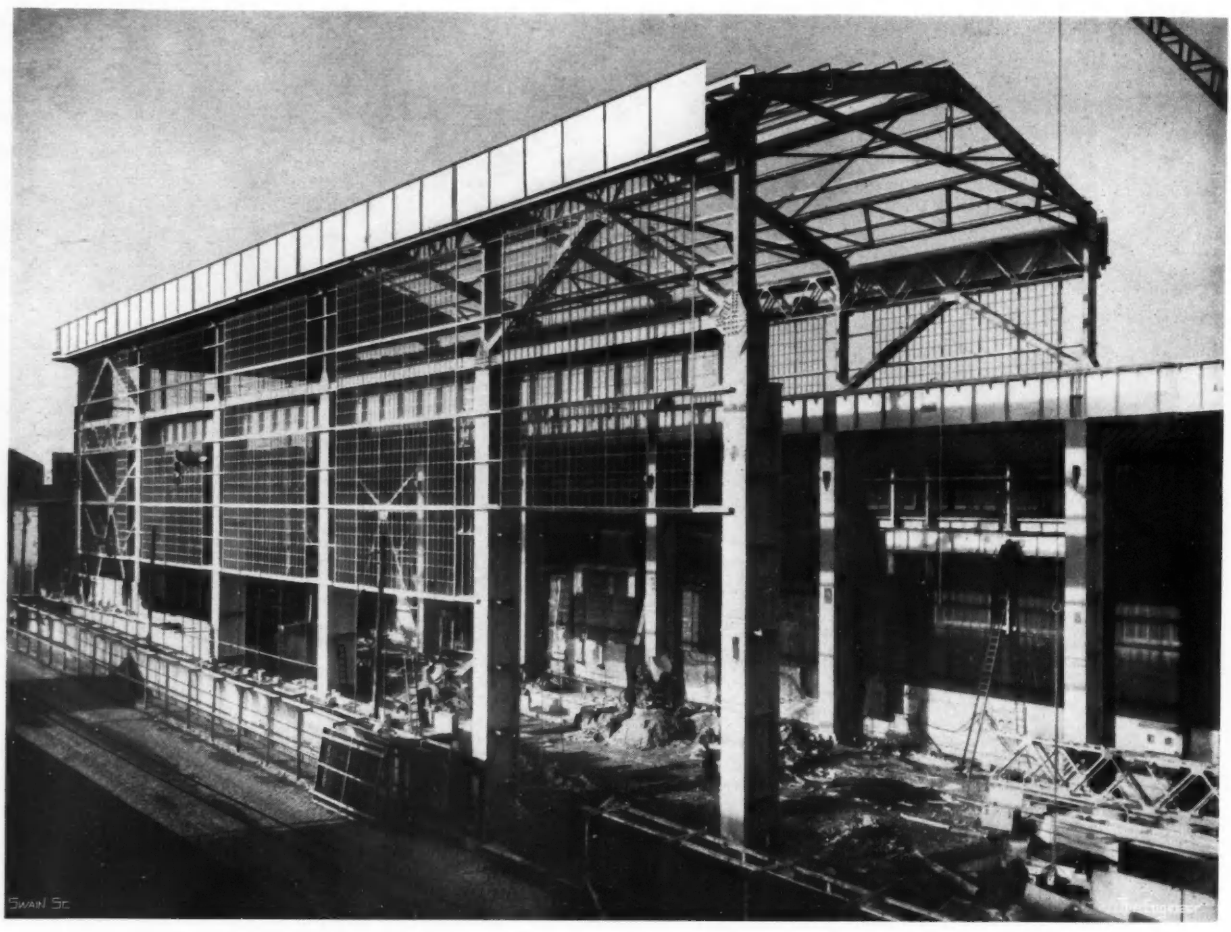






SWEDISH MINE LAYING DESTROYER "OLAND"
FRENCH AIRCRAFT TENDER "COMMANDANT ROBERT GIRAUD"
BRITISH WEAPON CLASS DESTROYER "BATTLEAXE"

ENGINEERING SHOPS COMPLETED IN 1948



LIGHT MACHINE BAY—GLENFIELD AND KENNEDY LTD., KILMARNOCK
NEW ALTERNATOR SHOP—MAIN STEELWORK UNDER ERECTION—C. A. PARSONS AND CO., LTD., HEATON WORKS

set the mould in which it grows. In the case of the trade unions these shaping factors were not confined to infancy but have continued throughout their maturity so that it should be no matter for surprise that their character and outlook are now coloured by them. In an economy of highly specialised production, the greatest danger to the standard of living of a working man is the loss of his job, for it is no easy matter to find another opening for his specialised skill or particular experience; and all the most important features of trade union policy have been primarily concerned with protecting their members from this danger. "Restrictive practices," the "go slow policy," opposition to the introduction of women on jobs previously done by men, strict demarcation agreements, limitation of the number of apprentices, opposition to the use of labour-saving machinery—all these and similar policies have the same origin: to prevent anything, competition from other workers or competition of other techniques, which might reduce the demand for, and hence the price of, the particular types of work by which members of the unions earn their living. Many of these policies have obvious repercussions which are inimical to the interests of other wage-earners. How could it be otherwise? For each union is organised to promote the sectional interests of its own members and not the welfare of the wage-earning community as a whole, except in so far as there are objectives which are recognised as common to all. This is no more a fault in trade unions than it is in any other society which exists to promote the common interests of its members. When a football club buys a piece of ground it does not feel it to be part of its social duty to make a full enquiry into all the other possible uses of the site—for a theatre, for example, or houses, or a public house, or a park or a factory; nor, when it engages a young man as a member of the team, does it stop to consider that this may narrow the field of recruitment for mining or textile manufacture or teaching, or any other work in which labour is in short supply. It bids in the market up to the price it thinks worth while for its own purpose and expects others to do the same. And, similarly, trade unions, with the constant bogey of unemployment haunting them, have not felt it part of their social duty to welcome new techniques that would throw their members out of employment because the improved productive methods might raise the standard of living of other sections of the community or to refrain from asking for higher wages because this might raise prices that others would have to pay. I recently asked an acquaintance of mine, an exceptionally able trade union leader, who had been transferred to the governing body of one of the newly nationalised industries whether his new experience had yet modified his views. "Very much so," he said. "When I was a trade union negotiator I felt it my duty to push wages up as far as I could; now I realise I have to count the cost."

Trade Unions and Productivity

In view of all this, the step taken by the Trades Union Congress during the autumn in calling a conference of the executives of trade unions with the sole aim of discussing how production can be increased is something of a revolution. "There was a time," said Mr. Will Lawther, Chairman of the Trades Union Congress and President of the National Union of Mineworkers, during a newspaper interview, "when I would have advised the miners and, indeed, every section of the workers to fight against the new speed-up machine which may cost you your job. That was in the bad days of slump and unemployment. But now the wheel has come full circle. With full employment the machine which was the worker's enemy yesterday has become his friend to-day. We cannot afford any Luddites in 1948. Efficiency is no longer just the boss's business. It is everybody's business, whether they work in a factory, farm, mine or office. If we are to overcome the economic crisis we must have new methods, new machines, new techniques, and make the best possible use of manpower which is our most precious asset."

It is the problem implied in the last sentence of this statement which has done more than anything else to bring about this radical change of policy. When the war ended there was confident expectation that the period of shortages would soon be over. The return to civilian employment of over 4,000,000 Service men and women, with the corollary of the consequent release of further millions from the manufacture of war equipment, seemed to presage a rapid increase in the supply of all the things we wanted, both for home consumption and for export. It was some time before the unreality of these hopes could be appreciated. A tremendous amount of constructive work was put into the task of converting the economy from a war to a peace basis and the smoothness of the administrative machinery by which such a large proportion of the working population were enabled to get back into civilian jobs is a matter of congratulation to all concerned. This orderly demobilisation naturally took some time, so that it was easy to assume that any industry which found itself short of manpower was in a temporary difficulty which would soon disappear when more Service personnel were released. It was not until demobilisation was complete that we were forced to recognise that such optimism was unjustified and that certain industries, such as cotton, wool and coal, whose expansion is vital to our economic stability, were seriously short of labour.

(To be continued)

British Railways in 1948

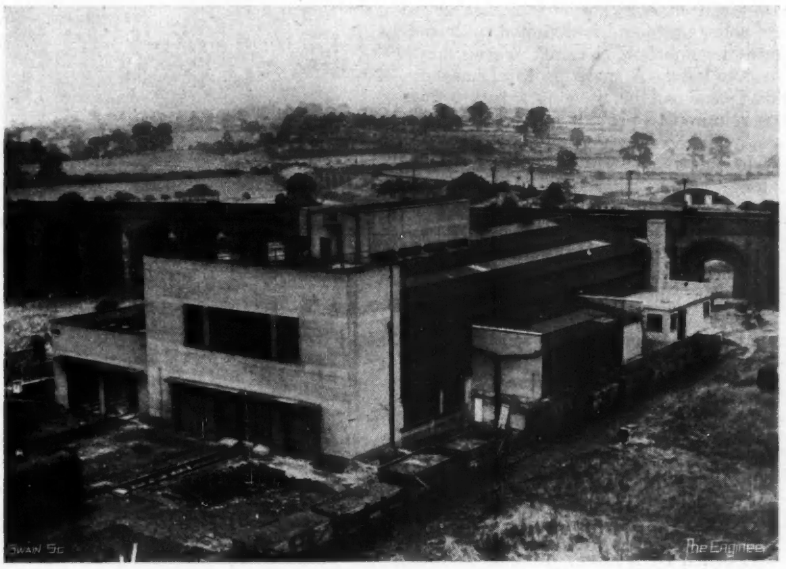
No. I

DURING the past year the reorganisation consequent upon the nationalisation of British railways seems to have proceeded smoothly, although a number of inter-regional adjustments have been made to promote economy and efficiency.

On the locomotive side, little, if any, development work of an outstanding nature has come to notice, although the results of the interchange of locomotives between the various regions are still awaited with some interest. The mechanical engineer's departments are still busily engaged in reducing the amount of work which accumulated during and since the war as a result of material and manpower shortages. The work accomplished by these departments has been apparent during the past few months, and train delays as a result of locomotive breakdowns have become comparatively rare occurrences.

A few works of some size were undertaken and completed by the civil engineering departments and we propose to deal with some of those to which a degree of interest attaches later in this review.

There is no doubt that the most interesting event on British Railways in 1948 was the opening of the locomotive testing station at Rugby—which was fully described and illustrated in our issues of November 12th and 19th. This station largely owes its inception to the late Sir Nigel Gresley, the chief mechanical engineer of the former London and North Eastern Railway Company, and to the initiative of that company and the former London Midland and Scottish Railway Company. These two com-



LOCOMOTIVE TEST HOUSE AT RUGBY

panies, in 1936, when a number of other original participants in the scheme fell out, decided to proceed jointly with the construction of a testing station for their own use. Work on the station was started and was well advanced in 1940, when it was suspended owing to the war and remained in abeyance until 1944.

The new testing station, a photograph of which we reproduce, stands on a site of about 8 acres, and consists of two buildings with road and rail approaches. The larger building, some 171ft long and 130ft wide, consists of the test house with an adjoining preparation shed and a coal bunker annexe. A small building, situated sufficiently far away to be free from noise and vibration, houses the offices and a chemical laboratory.

The test bench, on which a locomotive can be seen in our Supplement, has seven sets of roller units and is designed to accommodate locomotives having wheel bases up to 42ft long. A spare pedestal has been installed and can be used at a future date if it is required to provide an eighth pair of rollers, which will make possible the testing of locomotives with wheel bases up to 47ft long. Each roller unit is designed to support a maximum axle load of 30 tons, which is considered sufficient to satisfy any foreseeable increase in the size and weight of locomotives used in this country. Five of the roller units are coupled to Heenan and Froude dynamometers, each of which is capable of absorbing up to 1200 h.p., and designed for equivalent speeds from 19 to 130 m.p.h. The rated capacity of the testing plant is 4500 h.p. but it could be increased to 6000 h.p. should the need arise. The arrangement is such that each dynamometer can be controlled individually or the whole group collectively by means of a master controller.

Locomotives are anchored in position on the test bench by a heavy drawbar coupled to a dynamometer, by which the drawbar pull is both resisted and measured. This drawbar dynamometer is designed to withstand a pull of 40 tons and, together with a recording table, was supplied by A. J. Amsler, of Switzerland. On this table, which is similar to equipment used in dynamometer cars all over the world, is recorded the peripheral speeds of the driving wheels, the tractive effort, the power developed, and the useful work done by a locomotive.

A certain amount of work still remains to be completed on the new testing station, but when it is in full operation it will fill a long-felt want by the railways of this country, and its inception will have far-reaching effects on the promotion of efficiency and economy in locomotive design and running.

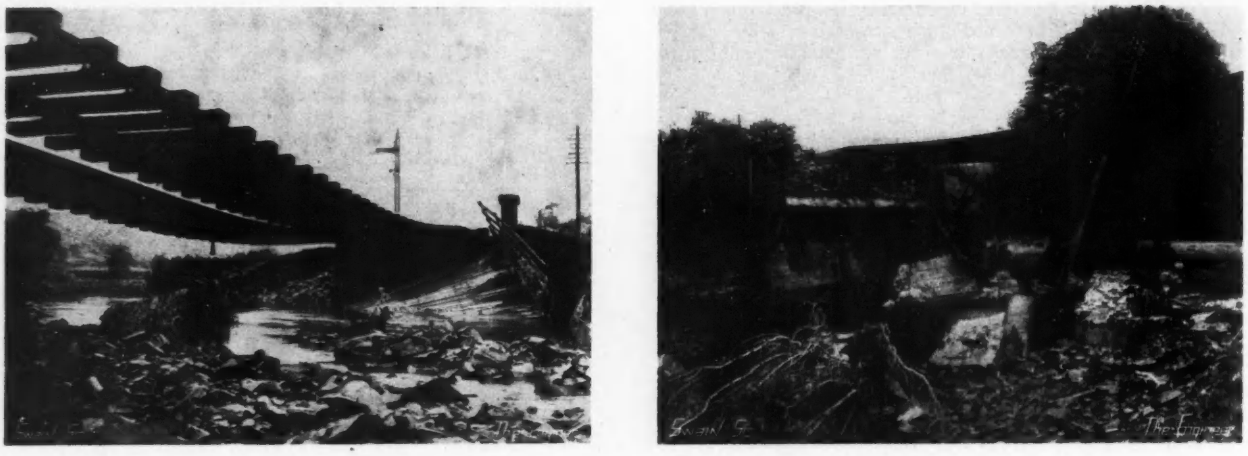
Flood Damage in the Border Country

Probably one of the worst situations presented to railway engineers in this country in peacetime for many years was the damage caused by heavy floods in the Border Country in August last. Days of continuous heavy rainfall in this area flooded many miles of track on the East Coast Anglo-Scottish line and the volume of rushing waters did a considerable amount of damage. In addition to carrying away a number of bridges, the rush of water weakened many others, buried the permanent way in some places, and undermined it in others.

Between Berwick and Burnmouth the line was practically buried by debris, and the embankment between Ayton and Reston was dangerously weakened by the vast area of water it impounded. Between Reston and Grantshouse seven bridges over the Eye Water were washed away and, as can be seen in the photographs we reproduce, considerable lengths of embankment on both sides of the bridges were also demolished. In addition to thousands of yards of permanent-way ballast being washed away between Grantshouse and Cockburnspath, large quantities of debris were deposited on the line. In this section also the embankment was undermined at no less than three places and the subsidences left the tracks unsupported over long gaps. To the north of Cockburnspath the foundations of a number of smaller bridges over burns were undermined and rendered unsafe.

In order to repair the havoc caused by the floods the material and manpower resources of the whole of British Railways was concentrated, and the technical assistance of the War Office, the Metropolitan Water Board, and other authorities was enlisted. The assistance and equipment of general contracting firms was also employed for the work. At the outset a central depot for the collection and despatch of structural materials, tools and military bridging equipment to working sites was set up at Darlington.

It was, of course, out of the question to replace the destroyed bridges with permanent structures in any reasonable time,



Remains of Harelawside and Barrel Arch Bridges

Church Fenton Junction before Renewal

and it was decided to substitute for them temporary, military type, bridges. In order to reduce the extent of the work the embankments scoured away on the ends of the original bridges were not completely restored and the temporary structures were made considerably longer than their predecessors.

Much of the line was restored and opened to service within two or three weeks, and even the worst damaged section was completed and ready for use in the remarkably short time of eleven weeks. In view of the work entailed and the conditions which prevailed, the reopening of the line in such a short time was a matter upon which all concerned were to be congratulated.

Eastern and North Eastern Regions

One of the biggest jobs carried out by the civil engineer's department of the North Eastern Region, and indeed one of the largest it has effected since the war, was the reconstruction of the tracks and the junctions at Church Fenton.

Church Fenton, situated about 10¼ miles south-west of York, is the place where the York to Leeds and York to Sheffield and Manchester (via Burton Salmon) lines separate. Prior to 1904 there was a double line of way from York to Church Fenton and double lines of way from Church Fenton towards Leeds, and in the Burton Salmon direction. In 1904 the York to Church Fenton lines were again doubled and the point at which these lines divided to become the Leeds and Burton Salmon lines became known as Church Fenton North Junction. At this point a double line branch from Harrogate also joins the main lines.

The junction as laid in 1904 consisted of forty-seven sets of switches and 101 crossings, including four diamond crossings where the branch line from Harrogate crossed the two Leeds lines before joining the Burton Salmon line. The switches and crossings to be seen in our illustration were renewed in about 1925, without any radical alteration to the lay-out. In 1945 it was decided that complete renewal was again desirable and various plans were prepared showing modifications of the existing lay-out by which considerable savings of track and improvements in alignment were obtained. By means of the rearrangement which has been effected, the diamond crossings in the Leeds lines have been eliminated and in general flatter leads have been introduced. Prior to the remodelling, the length of track involved in the junction was 2836 yards of point and crossing work and 777 yards of plain line. In the new lay-out the corresponding figures are 1700 yards of point and crossing work and 1055 yards of plain line. In the new lay-out there are thirty sets of switches and fifty-two crossings. The total cost of the work was about £30,000.

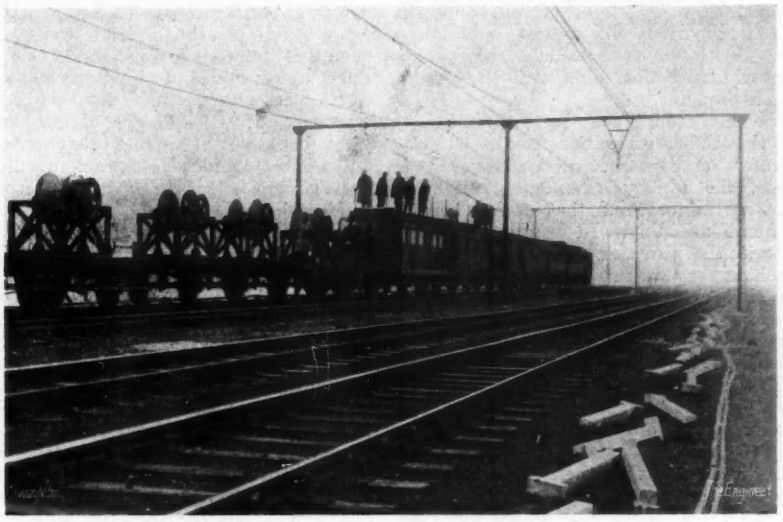
The actual renewal was carried out in a series of eight stages, each major operation being carried out on a Sunday. Other work was of course, carried out between the Sundays and in all extended over some three and a half months.

In connection with the Manchester-Sheffield-Wath electrification scheme an important part of the preliminary work was completed in October, when the new tunnel at Thurgoland was opened. At this part of the line lateral clearances in the existing double-line tunnel are limited because the tunnel was not accurately driven when it was built. Owing to the difficult operating conditions, it was decided as part of the new scheme to drive a new single-line tunnel to accommodate the down line and move the up line to approximately the centre of the old tunnel. The new tunnel, which is 330 yards long, is built in a curve of 40 chains and is lined for most of its length with concrete.

It is planned to complete the first of the three stages of this electrification scheme—the Wath-Dunsford section—in March, 1951. At present about 30 per cent of the foundations for the overhead-line equipment have been completed and 15 per cent of the structures erected.

Work is in an advanced stage on the Liverpool Street to Shenfield electrification scheme, in which some 110 single-track miles are being electrified. As the volume of passenger traffic over this stretch of line is exceptionally heavy, it is important that any breakdown that occurs through a fault in the overhead equipment should be localised. This has led to the introduction of a new system in which the contact wires on the various tracks on the open route are not registered through steady arms fitted to a common cross-span wire crossing all tracks from mast to mast; instead, separate Y-frames for each track are suspended from the bridge of the supporting structure and each contact wire is held in position by a steady arm fitted to an insulator on the end of a Y-frame. This arrangement can be seen in the installation photograph we reproduce.

The structures are of two distinct types. Supporting structures for two, three or four tracks are of simple, broad-flange beams, and the anchor or terminal structures are of the normal lattice-type, as are also the larger supporting structures spanning more than four tracks.



Electrification of Liverpool Street–Shenfield Line

(To be continued)

Nuclear Energy in 1948

THE year has proved disappointing to those who hoped for a substantial approach towards an international scheme for the control of atomic energy. Although the Atomic Energy Commission had been created by the unanimous decision of the United Nations, its comprehensive reports of December, 1946, and September, 1947, did not obtain unanimous endorsement, and the ten votes in its favour out of a possible twelve were not sufficient for a measure which would need the covering endorsement of the Security Council, on which U.S.S.R. (one of the objecting States) had the power of the "veto." And little visible progress was made during 1948 in the effort to find some acceptable compromise; whilst so many, and bitter, recriminations were made as to the alleged motives of the majority States, that in May the Commission, in despair, came to the decision by majority vote, to advise the General Assembly that the work of the Commission should be suspended until such time as a more favourable political atmosphere was reached. This proposal was discussed at length at the Paris meeting, and early in November it was resolved, on a motion from Canada, by forty votes to six with four abstentions, that the six States, viz., the Great Powers with Canada, which had sponsored the initial setting up of the Commission, should be asked to determine whether there could not be found some "basis for agreement on international control of atomic energy and prohibition of atomic weapons," and that a special committee should advise whether the Commission should resume its sittings and proceed to the further study of those subjects remaining in its original programme. Everyone will hope that these new steps will prove successful, for their failure would mean the abandonment of the effort to find a unanimously acceptable scheme, leaving only the alternative of a purely regional settlement applicable solely to the western States; unless, indeed, the view should come to be accepted that the Commission had aimed at an unduly high standard of world security, and that, in the light of later views of the probable effect of the bomb if used in a conflict between major Powers, a less ambitious aim could be substituted.

Recent Technical Developments

Very little is disclosed by Governments of their activities in atomic energy research. This is natural when military application is the main objective, but it rules almost as strictly in respect of any form of extensive civil use, since at the present time the plants necessary for these two very different ends

are almost identical for most of the way. The Lilienthal scheme for separating them by a kind of denaturing procedure has unluckily not yet proved sufficiently "rogueproof" to be acceptable.

Most of the military effort is, and may well continue to be, American, but it is not so clear that this will apply to the civil objective of power production. The U.S.A. is said to have a 2000 years' reserve of coal; hence the many countries by no means so blessed have a proportionately stronger inducement than America to press on with the development of this possible addition to the present sources of power.

The chief atom bomb plants in the U.S.A. are the U.235 separation plants (electromagnetic and gaseous diffusion) at Oak Ridge, the rapidly extending plutonium plant at Hanford, and that at Los Alamos for bomb assembly. In the research laboratories the provision of billion-volt atom smashing apparatus grows apace. On the civil side the chief objective of the research effort is, it appears, the development of a process temperature high enough to be capable of application in a turbine, whether gas or steam, for producing electric power. One such effort, at Los Alamos, makes direct use of plutonium as fuel, care being taken no doubt that the lumps used are below the dangerous chain-reacting size; another such plant at Brookhaven, on Long Island, uses natural uranium. Many alternative schemes have also been reviewed and some may by now be on the way. One of the most adventurous is a plan to make "breeding piles"—that is, reactors using natural uranium in which the 235 element, on being "burnt," converts an equal or greater amount of 238 into further burnable material and so enables the whole of the 238 to be converted, thus increasing the possible energy output more than a hundredfold. In existing plants this favourable balance has by no means been reached, but the advantage to be gained by its achievement would be so exceedingly important that energetic work in this direction can hardly fail to be undertaken in all countries having the necessary facilities.

An important reference is made to the importance of breeding in the fourth semi-annual report of the U.S. Commission on atomic energy, issued in July last. If the cost of uranium remained at about its present level, and breeding were technically practicable, a new fuel industry might, it is forecast, be created, comparable to, or even larger than, the present coal industry and operating at a lower cost. Warning is given, however, that the cost of a nuclear fuel plant might prove to be substantially higher than that of a coal-burning plant of equal capacity; this disadvantage would have to be borne in mind when considering the economics of the position, but it would hardly be likely to deter those countries where the present supplies of natural fuel are meagre.

Of specific military developments all that the U.S. Government has revealed is that some important scientific tests have lately been made at the new experimental station at Eniwetok of improved types of atom bombs, showing, it is said, a substantial gain on earlier models. Including civilian personnel, the "task force" engaged on these tests numbered nearly ten thousand. Emphasis was placed on ascertaining the scientific quality of these new weapons, whereas the earlier tests at Bikini had aimed at the quantitative measurement of the effects on the target rather than on the actual generation and nature of the nuclear fission which took place.

It can be deduced from Professor Tilly's estimates in the Chatham House report, published last January, that the upper mile or two of the earth's crust contains not merely millions of tons of uranium, but millions of millions, with even larger amounts of thorium; this superabundant quantity, in view of the small amount needed to produce a plentiful supply of energy, might seem to remove all possible anxiety as to any conceivable scarcity of the necessary raw material, for, according to Sir John Cockroft's estimate, the present energy consumption of the whole world would be met by the complete fission of as little as 200 to 250 tons of uranium a year. But this precious substance is exceedingly thinly spread throughout most of the rocks that contain it, and a new technique for extraction will need to be devised before these potential resources can be effectively utilised.

This is but the more difficult end of a problem of which we are likely to hear a good deal in the coming years. The known reserves of the richer ores of some of the most widely used metals are reported to be within sight of exhaustion, and it seems certain that a greatly improved technique for extraction from ores of lower grade will become necessary. There is here a challenge to mining engineers and metallurgists, the importance of which can hardly be exaggerated. It is, no doubt, the difficulty likely to be encountered in the economic extraction of uranium from low-grade ore, and of the difficult problem of ascertaining the right materials for the construction of reactors, that have led certain eminent atomic scientists to give such widely different forecasts of the date when atomic energy in civil applications is likely to prove of real use to the world. Estimates ranging from a few years to half a century are put before us with equal confidence.

In Britain the Government's main effort is centred at Harwell, with its two atomic piles, "Gleep" (graphite low energy experimental pile) and "Bepo" (British experimental pile with O for euphony). The former has been operating for a year or more and is a modest plant of low power entirely for research purposes. The latter has the dual purpose of the production of large quantities of radioactive tracer isotopes for investigations in medicine, agriculture and metallurgy, and for the study of the changes caused by intense radiation fields in the physical nature of the materials used in the structure of power piles.

In both "Gleep" and "Bepo" the uranium is understood to be in the form of rods built into a horizontal cylindrical lattice with graphite as moderator, whilst from a shielded observation room the neutron absorbing control rods are so moved that the chain reaction ratio is kept in the neighbourhood of unity.

When Harwell was visited by representatives of the press in July last, Sir John Cockroft explained that the establishment he controlled aimed primarily at the application of nuclear power to industrial purposes. Besides the important study of "breeding" and of the materials best suited to pile construction to which we have referred, he mentioned the other lesser ones of cleansing the nuclear fuel prepared for civil purposes from the intensely radioactive ash produced with it, and of disposing of the large amount of similar ash which would be a by-product of the power stations working on nuclear fuel. The solution of all these problems must take time, and Sir John did not see how nuclear energy could make an appreciable contribution to world power during the next ten years.

The aggregate British effort, as is natural in these austere days, is on a modest scale compared with what is being done in U.S.A.; and, so far as is known, what is being done in other countries in Western Europe is more modest still. What is happening on the far side of the Iron Curtain is carefully hidden, but it may well be that there is really very little to hide. America has a very long lead and is most unlikely to be rivalled if she continues to work on the subject with her present energy.

Nuclear Power in Mobile Units

Many forecasts have been made of the application of nuclear power for seagoing vessels and even for aircraft. Its use for ship propulsion is much the simpler, since the saving of fuel bunker space, as well as its weight, should easily enable provision to be made for the heavy and bulky shielding against radioactivity needed for the safety of the ship's personnel. The aircraft problem is much tougher; nevertheless there have been several optimistic press reports of surprisingly hopeful schemes, that, for instance, a "pile" has already been built in a form compact enough to be portable, and that plans are now in hand in U.S.A. for a large nuclear-powered aircraft, which will, it is hoped, provide an adequate degree of shielding and yet be within the space and weight available. The Fairchild Engine and Aircraft Corporation have, it is understood, accepted a contract for such developmental work.

Hitherto atomic energy, has been obtained from the fission of the heavy unstable elements of the periodic table, but the energy that supplies the sun's heat is believed to be due almost entirely to the combination in its interior of such light elements as hydrogen and helium. If this could be done on earth, as seems somewhat unlikely, since—as at present believed—the temperature necessary to start the reaction has to be somewhere in the millions of degrees (as in an atom bomb during the moment of actual explosion), the energy obtainable from a bomb of the present size might well be 1000 times as great as hitherto. Luckily, this "improvement" is estimated, even by so optimistic an authority as Professor Oliphant, to be still half a century ahead—and for that breathing space the world may be thankful.

Schemes for International Control

It may be that nothing short of the far-reaching majority scheme produced by the Atomic Energy Commission could give the "100 per cent security" objective at which the Commission aimed. This scheme finds it necessary—and the case is excellently argued—to have the products of all uranium and thorium mines internationalised; indeed, that such products should be owned, transported and operated either directly or under licence by an Atomic Development Authority (A.D.A.) under the United Nations with careful inspection by an international staff to ensure that no clandestine operations were undertaken anywhere at any time. To such an inspectorial inquisition it would be natural for any country to be inclined to object, for it would mean uncovering all its industrial activities whether confessedly concerned with atomic energy production or not; but so intense has been the dread of failure to reach an adequate degree of control that no less than three-fourths of the United Nations found themselves ready to assent to these drastic requirements. Russia, however, did object. She disliked the scheme, not only on ideological grounds, but in particular that part of the control proceedings which might disclose to other countries just where her chief munitions plants were

situated. As other countries would be open to precisely the same kind of disclosure and yet have thought the risk worth taking, it is profitable to consider the reason for this great difference in attitude. Most of the countries in Europe are small, especially when compared with the U.S.A. and the U.S.S.R., and are easily reached by large aircraft coming from either of those two extensive States. They certainly can have no wish to take any part whatever in an atomic war, and their only fear is lest they may find themselves involved in one because it suits some powerful neighbour that they should. Therefore they have little to lose by accepting international inspection and much to gain if by that means aggressively-disposed States are hindered in their aims.

So intermixed are the military and civil uses of nuclear energy that it is hard to separate them. It may help in the clarification of our minds to consider at what conclusions we should arrive if, by some hitherto undiscovered process, the energy for civil purposes could be derived from the raw metal without at any stage producing an explosive substance, and even go so far as to assume that no means were known for producing explosive products. In that pleasant—but unfortunately non-existing—state of affairs, every country that possessed mines capable of producing uranium or thorium would proceed to develop them as rapidly as they could, and those that had not any would purchase supplies through the ordinary methods of international trade. Information as to the best technique would freely pass between the engineers concerned and the normal royalty systems would serve to ensure that invention had its due reward. That would be a happy state of affairs. America could be generous in sharing her knowledge and would not need to hedge that generosity with prickly conditions; the U.S.S.R would not need to be suspicious about the moves of other States. But if in this hypothetical Utopia, some inventor were suddenly to find that explosive material—let us say, as explosive as ordinary H.E.—could be got from uranium, the picture would change—a much more cautious attitude would come into existence, and exports would no doubt cease until the position was clarified. If this addition to the world's supply of explosives were then seen to make little difference to the total amount easily obtainable by other means, the risk introduced by the new discovery might be ignored in consideration of the general utility of nuclear power for civil uses. But if discovery went further and laid bare the means of producing from uranium the atom bomb, as we know it to-day, a drastic change for the worse in the situation could not fail to be produced, and the world would speedily reach that near-deadlock position with which we are unluckily so familiar. Is there any way in which an easier situation could be reached?

In recent months prominent Soviet politicians have made much of certain arguments advanced in a recent book by Professor Blackett on the military aspects of atomic energy. Professor Blackett, the latest Nobel Laureate in Physics and a professor at the University of Manchester, is a very able product of the Cambridge school of Rutherford's day, and what he has to say—on any subject of which he is master—must command attention. On the political aspects of atomic energy control his views may be tinged by left-wing sympathies, but the facts he brings forward and the arguments he bases upon them deserve careful consideration. The chief question he raises is whether the widespread fear of the terrific potentiality of a few atom bombs is justified. He endeavours to show that it is not, on the ground that no fewer than 400 such bombs would have been needed to produce the destruction caused in Germany by the million or more bombs of normal type used in the area bombing of that country by American and British aircraft in the late war. From this he deduces that it is quite unnecessary to add to the difficulties—in any event sufficiently considerable—of devising an acceptable form of international control by aiming at what he terms the "100 per cent security" standard set as its target by the U.N. Atomic Energy Commission. He would prefer some simpler scheme, one which, even if it did allow a dozen or two bombs to slip through its meshes, would none the less suffice to prevent any stockpiling by any Power; and he suggests that if this policy were followed, the U.S.S.R. might be ready to take its place in the plan. This, he thinks, would be better than the continuance of the present deadlock with its inevitable encouragement of an atomic armament race.

These considerations will no doubt receive careful attention in the new attempt being made, following the decision of the General Assembly, to ascertain whether it may not even now be possible to find a means to include all the Great Powers in a single scheme.

Naval Construction in 1948

By FRANCIS McMURTRIE, A.I.N.A.

No. I

BY far the most important of the new warships ordered in the past year is a gigantic aircraft carrier for the United States Navy. This again emphasises the extent to which this category has thrust the battleship into the background.

Only a single battleship—the "Missouri"—remains in commission in the United States Fleet, contrasted with twenty-one aircraft carriers. In the Royal Navy the situation is similar. Though the battleship still has plenty of supporters, there is no denying the fact that its big guns are completely outranged by the aircraft of the carrier, to say nothing of the guided missiles with which so many experiments have recently been undertaken. The battleship's principal asset to-day is its capacity to stand a great deal more battering than any other type of warship.

No surprise need therefore have been felt that over a dozen battleships should have been discarded by various powers during 1948. Yet there was no lack of protests when such well-known ships as the "Nelson," "Rodney," "Queen Elizabeth," and others were condemned.

British Navy

Two of the light fleet carriers of the "Majestic" class, H.M.C.S. "Magnificent," and H.M.A.S. "Sydney" (ex-"Terrible") have at long last been completed for the Royal Canadian and Royal Australian Navies respectively. A third of this 14,000-ton type, the "Majestic," may possibly be ready in the near future, to judge from a recent reply to a question in Parliament. There were persistent reports that the remaining three, H.M.S. "Hercules," "Leviathan," and "Powerful," launched in 1944–45, might be abandoned. Official statements on the subject, while admitting that the contracts for these ships had been cancelled under a time clause, intimated that no decision had been taken to annul their construction entirely.

Though any abandonment of ships so far advanced is to be deplored, it must be admitted that the type—which is in its main features identical with the "Colossus" class—leaves a good deal to be desired. A speed of 25 knots cannot be regarded as adequate for a carrier operating with a modern fleet, while the number of aircraft accommodated—about forty at the most—is relatively small, considering the high degree of wastage to be expected. If three larger carriers of more up-to-date design were to be ordered, the bulk of the material already built into the three ships mentioned could probably be utilised.

A carrier of the 18,300-ton "Hermes" class, H.M.S. "Bulwark," was launched by Harland and Wolff Ltd., last June. This leaves only one of the four ships of the class on the slip, the "Hermes," at Barrow. No further progress has been reported with the "Ark Royal" and "Eagle," the displacement of which is now officially given as 36,800 tons.

No work whatever appears to be in progress towards the completion of the cruisers "Blake," "Defence," and "Tiger." It has been suggested that the "Defence" may never be finished, though she was launched over four years ago; but the official answer to this report is the same as in the case of the carriers "Hercules," "Leviathan" and "Powerful."

None of the eight large destroyers of the "Daring" class has yet been launched, nor is there any news of expected launch dates. On the other hand, all four of the "Weapon" class have passed into service. Though in some quarters these ships have been severely criticised on the grounds of their grotesque silhouette and the limitation of their main armament to four 4·5in guns, it is understood that they have proved highly successful in various exercises in which they have been engaged.

Submarines of the "A" class, fitted with the "Snort" apparatus, appear to have given great satisfaction in special trials during 1948, the "Alliance" and "Ambush" having operated in submerged condition for record periods.

At least two motor torpedo boats of experimental design are reported to be in hand or complete. "M.T.B. 538," built by Vosper, Ltd. is one of these; the other, constructed of aluminium alloy by Saunders Engineering and Shipyard, Ltd., Beaumaris, was launched last April, but little has since been published concerning her trials.

Further trials with gas turbine engines have been carried out in "M.G.B. 2009," it is understood, with satisfactory results. Other designs are being fitted in larger vessels, one of which is the gunboat "Grey Goose" and the other a frigate.

H.M.S. "Reclaim," the new deep-diving tender to the "Vernon" establishment, is now in service. She is specially equipped for submarine rescue work, though it has been suggested that her low speed, only 12 knots, might prove somewhat of a handicap in emergency.

Four Canadian-built ships of the "Fort"

type have been acquired for service as fleet supply ships, their names being "Fort Beauharnois," "Fort Charlotte," "Fort Duquesne," and "Fort Rosalie."

The list of ships discarded during the past twelve months is an extensive one. It includes the battleships "Nelson," "Rodney," "Queen Elizabeth," "Valiant," "Malaya," "Ramillies," "Resolution" and "Revenge"; the battle-cruiser, "Renown," the escort aircraft carriers "Nairana" and "Vindex," and the cruisers "Scylla," "Orion," "Kent," "Berwick," "Suffolk," and "Cumberland." Some of these ships have been utilised as targets for various forms of attack.

It is over a quarter of a century since such a large group of battleships was discarded, and the effect has been to reduce the total number of units of this category to five. So far as cruisers are concerned, the end is not yet, as H.M.S. "Arethusa," "Ajax" and "Leander" are also earmarked for disposal. Thus, apart from ships of Dominion navies, the total number available for service to-day is no more than twenty-seven.

All destroyers of pre-war construction have now been removed from the effective list, and some of the earlier war-built ones are likely to follow. The submarines of the "U" and "V" types have been paid off preparatory to disposal, together with some of the earlier units of the "S" class.

Sales to Dominion and foreign navies have been numerous. They include the cruiser "Delhi," ex-"Achilles," to the Royal Indian Navy, which has also arranged to purchase the destroyers "Rotherham," "Raider," and "Redoubt," while the "Onslow" and "Offa" are to go to the Royal Pakistan Navy. The aircraft carrier "Terrible" has been taken over by the Royal Australian Navy and renamed "Sydney," and the "Magnificent" has been lent to Canada. Six frigates have been acquired by New Zealand and one by Burma.

China has purchased the cruiser "Chungking," ex-"Aurora," and the destroyer "Lin Fu," ex-"Mendip." The Dominican Republic has obtained the destroyers "Fame" and "Hotspur." The Royal Netherlands Navy has acquired the aircraft carried "Venerable," since renamed "Karel Doorman"; the destroyer "Marnix," formerly the "Garland"; the submarines "Zeehond," ex-"Tapir," and "Dolfijn," ex-"Taurus," and the supply ship "Pelikaan," ex-"Thruster." Portugal has bought the submarines "Saga," "Spearhead," and "Spur," renamed "Nautilo," "Neptuno," and "Narval" respectively, and the frigates "Avon" and "Awe"; while Siam has received two corvettes, formerly the "Burnet" and "Betony," and a minesweeper, ex-H.M.S. "Minstrel."

Dominion Navies

Two destroyers of the "Battle" type, the "Anzac" and "Tobruk," are completing for the Royal Australian Navy, and four more of the slightly larger "Daring" type are on order. New Zealand is arranging for the purchase of a surveying vessel from the Royal Navy, in addition to the six frigates already acquired.

In the division between India and Pakistan of the ships of the Royal Indian Navy, the former retained four sloops, two frigates, one corvette, twelve fleet minesweepers, one surveying vessel, four trawlers, four motor minesweepers, and four motor launches; while the Royal Pakistan Navy has two sloops, two frigates, a training ship, two trawlers, four fleet minesweepers, two motor minesweepers, and four motor launches as the nucleus of the future fleet.

France

It does not appear as though finances had yet permitted a start to be made with the new 16,700-ton aircraft carrier ordered from the Penhoët Yard, St. Nazaire. The battleship "Jean Bart" has at last been completed and differs somewhat in appearance from her sister ship, "Richelieu," as will be seen from the accompanying illustration. Her anti-aircraft armament is a more powerful one, comprising twenty-four 3·9in and twenty-eight 57mm guns.

Ships taken over from Italy under the terms of the Peace Treaty include the cruisers "Attilio Regolo" and "Scipione Africano," the third ship of the type, "Pompeo Magno," being dismantled to provide spare parts; the destroyers "Legionario," "Mitragliere," "Velite" and "Alfredo Oriani"; the sloop "Eritrea," and the oiler "Tarvisio." Respective new names conferred upon these ships are :—

Cruisers : "Chateaurenault," "Guichen."

Destroyers : "Duchaffault," "Jurien de la Gravière," "Duperré," "D'Estaing."

Sloop : "Francis-Garnier."

Oiler : "Garonne."

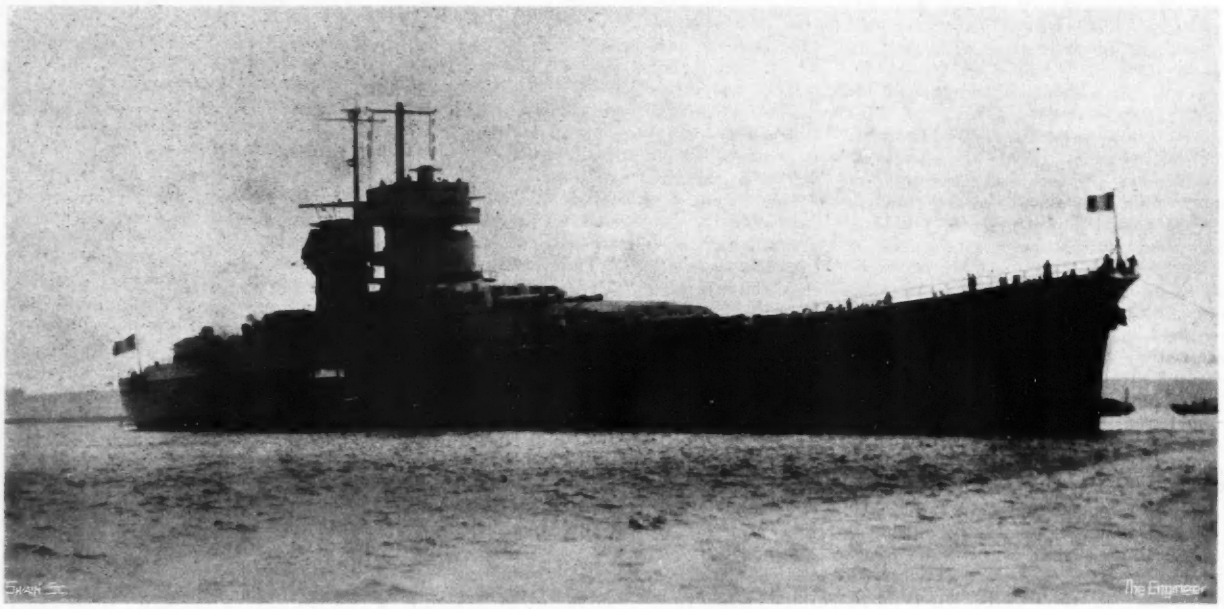
Two motor torpedo boats, six tugs and three water carriers have also been transferred from the Italian flag.

Four ex-German submarines, which were abandoned in more or less damaged condition in French harbours, have been reconditioned and placed in commission under the names "Blaison," "Bouan," "Laubie," and "Mille."

Twelve ex-German minesweepers of the "M" series have been taken over and refitted as Avisos, their names being "Ancre," "Belfort," "Craonne," "Peronne," "Vimy," "Ailette," "Bapaume," "Laffaux," "Meuse," "Oise," "Somme," "Yser." A number of ex-German vessels of the trawler type have also been put into service as surveying tenders, the "Alidade," "Astrolabe," "Boussole," "Octant," "Estafette," "Sentinelle," "Crabe" and "Tourteau."

Four ex-American frigates have been acquired and adapted for weather observation in the North Altantic, being renamed "Laplace," "Le Brix," "Le Verrier" and "Mermoz." Officially these vessels belong to the Ministry of Transport and Public Works but they are manned by the French Navy.

(To be continued)



FRENCH 38,500 TON BATTLESHIP "JEAN BART"

Electric Power Production in Europe.—The Organisation for European Economic Co-operation has recently stated that electric power production in Western Europe in 1948 was approximately 10 per cent higher than in 1947. This rising trend in power output is expected to continue as coal production increases in the countries participating in the European Recovery Programme. The Organisation, it is reported, is working on a comprehensive development programme to meet the present electricity shortage, and when the plans are carried out, it is estimated that the total increase in power generating capacity, by 1951 or shortly after, will be 23,751,000kW. This will represent an expansion of 49 per cent over the 1947 capacity.

Coal in 1948

By Sir RICHARD A. S. REDMAYNE, K.C.B.

No. I

ONE of the drawbacks in reviewing the annual record of the coal mining industry is the absence of complete and detailed statistics for the year in question, as these do not appear until well into the succeeding year. One has therefore to rely largely upon estimates.

Taking a general view of the European situation, the subject of coal has loomed largely in its economics,—indeed, in world economics,—during the past year.

If we take, as a guide for determining the annual coal requirements, the quantity of coal imported by the European countries during the last normal year before the World War, namely, 1938, this amounted to 104,927,159 tons, for, paradoxically as it may appear, such coal producing and coal exporting countries as Poland, Czechoslovakia, Germany and Holland were also considerable importers of coal. France, though a large producer of coal, exports none but is a considerable importer thereof. It would appear, therefore, that about 100 million tons is the extent of the normal coal requirements of Europe over and above her production of that commodity; but with the decrease in her production of solid fuel, owing to the aftermath of war, the demand for imported coal must have exceeded the normal figure during the past year.

Normally, of Continental Europe's coal requirements, Great Britain supplied about 50 million tons, Germany up to 30 million and Poland about 15 million, and other countries 5 million. Now the position is very different. The deficit—of 100 million tons at least—is being met, in part, by importation from the U.S.A. But it is interesting to note the revival of the Polish coal mining industry, for in 1947 her exports of coal amounted to 19·4 million tons, i.e., an increase of 30 per cent as compared with the previous year. In point of output the improvement witnessed in 1947 was continued throughout the past year. There is little doubt that the nationalised coal industry of Poland is supplying Russia with coal, of which the latter must be short in view of the injury inflicted on its collieries by the German invasion. The Ruhr, with the exception of the coal which Germany is obliged to send to France, has not lately been an exporter. In fact, that coalfield with an output of about 6·7 million tons a month has been producing during the earlier part of the past year only about 64 per cent of its pre-war contribution, though an improvement set in during the late autumn. Czechoslovakia is an exporter to some extent and is able to send coal to the neighbouring countries, notably Austria, but her annual output amounts to only about 39 million tons. France has always been a large importer of British coal. On July 15th last, however, the N.C.B. informed the Board of Trade that that country proposed for the next two months to buy no more British coal owing to the exhaustion of sterling with which to pay for it; as was suggestively hinted in some economic circles at the time, was this a challenge to the decision to impose an increase of 25s. per ton on all coal exported by us?

As has been already remarked, Holland, with her twelve collieries, is both an exporter and importer of coal, and she sends some small quantity to France. Belgium is chiefly concerned to meet her own needs. This leaves Russia and Great Britain, of the European coal-producing countries, to be accounted for from the point of view of meeting Europe's needs. Regarding Russia, little reliable information is forthcoming. The Iron Curtain obscures much and recent coal statistics are not available But, as has been stated, she cannot as yet be an exporter of coal in view of her own needs. Turning to Great Britain, we hope that our coal exports over the past year will have amounted to 15 million tons, much of which would go to the Continent, for Norway, Sweden, Finland, Denmark, Spain, Portugal and France have in the past proved good and regular customers of ours, but I doubt greatly whether the anticipated and hoped-for figure of 15 million tons will have been reached by the end of 1948.

U.S.A. has proved lately a good friend to Europe in the matter of coal owing to her huge output (in 1947) of 619 million short tons (about 16 per cent above the 1946 figure), which, after satisfying the home needs, left 46 million short tons for export and stocks. But it is clear that there is a decided limit to the extent to which U.S.A. is enabled to ameliorate the European coal famine.

We learned early in September that efforts were about to be made by the Economic Commission for Europe to make the Continent completely independent of coal from the western hemisphere. Eighteen countries, comprising the principal coal-producing and coal-consuming countries of Europe, as well as the United States, took part in the discussions. The European coal-exporting and importing countries are to notify to the E.C.E. quarterly both their import requirements and their export supplies. We learn, too, that approximately one pitprop is required for each ton of coal mined (which means in total an immense demand for pit timber), and it was agreed that those countries importing this timber should contract for only two-thirds of their 1948 requirements, and that a final allocation should be made later in the year.

Nationalised Coal Industry in Europe

The coal mining industry of nearly all European coal-producing countries is working under systems of nationalisation. Germany is one of the notable exceptions, so far. At present the coal mining industry of that field is under foreign control, and what its eventual condition will be when that control is removed and the collieries are restored to Germany it is too early to state. The systems of nationalisation vary greatly in the different countries, from totalitarianism in Russia to the devoluntary system of Belgium, where the State merely exerts a general control over distinct groups, which preserve a large measure of independence.

In France the industry has suffered from its nationalised system. As a leading British periodical, which keeps well abreast of world opinion in regard to the mining industry at home and abroad, remarked, in an interesting leading article in its issue of July 16th last, "It is not surprising that nationalisation is becoming less popular with the people of France, or at least those of them who are denied its direct benefits, a trend which can unquestionably be matched in this country also."

The Board for the northern coalfields of France, in its report for 1947, showed a drop in individual output, increased absenteeism and a decline in quality. The Director-General of Charbonnages de France, who resigned that office at the beginning of the summer, stated: "As long as political factors play a paramount role in the management of the coal mines, and as long as they remain, as they have done during the past year, the chief theatre of political strife, no one can expect that their operations will yield satisfactory results." The colliery managers in the Pas de Calais complain bitterly that their authority is flouted to such an extent that it is impossible for them to carry out their duties properly. This is probably a defect inherent in a centralised and bureaucratic system of control, and it would appear that we are experiencing a somewhat similar defect in our own coal industry.

On October 4th the miners throughout all the French coalfields, numbering about 320,000, came out on strike at the instigation of the Communistical French Miners' Federation, but the strike fizzled out by the end of November, largely owing to the military protection afforded to the willing workers. The miners gained nothing by the strike and the nation lost 4,600,000 tons of coal.

The Czechoslovakian coal industry, which was recently nationalised, follows most closely the British model, but with important variations. Supreme authority is vested in a part-time Council, which meets once a month. Day-by-day business is conducted by a general director with three deputies, one for planning, one for production, and one for finance, marketing and commercial policy generally. Below these again are specialists. Complaints as to the ill effects of bureaucracy are not infrequent and output continues to cause anxiety.

In Holland three eminent mining men act as directors of the four State-owned mines, which are carried on as if privately owned, the only difference being that the State is the sole shareholder. The other eight collieries are privately owned.

Some Notable Views on Nationalisation

Mr. Chifley, the Prime Minister of Australia, early in September last, told meetings of miners in the Northern New South Wales coalfields that the Government did not intend to nationalise undertakings other than public utility concerns which are not doing their best under private enterprise. He said that there was no evidence that nationalisation of the coal mines would improve the position, that the miners themselves had proved that in the State-owned mines. One wonders whether he had in mind, too, British experience and the words of the late Minister of Fuel and Power (though Mr. Shinwell is a firm believer in and advocate of nationalisation), when addressing the Co-operative Congress at Edinburgh on May 2nd last, he said: "When the mining industry was nationalised—this had been on the Labour Party programme for fifty years—we thought we knew all about it; the fact of the matter is we did not." He said, too, that they found themselves up against extraordinary difficulties, and continued: "We must be extremely careful that these difficulties do not ultimately destroy the whole conception and make it impossible to proceed further in the direction of nationalisation."

Let us look at nationalisation from the sociological point of view—the relationship

of workmen to management. The views of Viscount Simon, given in an article in *The Sunday Times* of September 12th last, are of special interest, coming, as they do, from one who has served his country in very varied capacities—Home Secretary, Foreign Minister and Lord Chancellor. "To most people the result, now that more than three years have passed, seems dismal and disappointing to a degree. The application of Socialist doctrine in practice is found to involve the sacrifice of individual liberty and the exaltation of petty Governmental interference to lengths hardly to be endured. Nationalisation, instead of humanising industry, merely substitutes for the private employer a remote and peremptory 'boss,' whose service no wage-earner, however dissatisfied, can leave with any prospect of finding employment in his trade with someone else." As General Eisenhower said in his inaugural address on the occasion of his installation as President of Columbia University on October 12th last, "The real threat rests in the fact that, if carried to its logical extreme, the final concentration of ownership in the hands of a Government gives to it in all practical effects absolute power over our lives."

We were informed early in March that the Government had appointed a Committee of Ministers under Mr. Herbert Morrison to inquire into the working of nationalised industries and that the Committee was at that time investigating the machinery of the National Coal Board. Is the Government realising that the working methods are paralysing enterprise by their rigidity?

We return to a consideration of nationalisation later on in this article as affecting the Brown Coal Mining industry.

The Mining Industry of Great Britain: Production and Export

The coal target aimed at for 1948 was an output of 211 million tons—200 million tons from the mines, or 14½ million tons more than the 1947 output therefrom—and 11 million tons from opencast workings; and provision was to be made for the export of at least 15 million tons, inclusive of bunkers, leaving for home consumption 195 million tons as against 184 million tons in 1947.

It is doubtful whether this forecast will be achieved. The return to an active export trade is, however, of heartening import; a comparison in this respect with previous years is of interest:

	1938	1946	1947
Coal exported ...	35,856,200	4,454,500	1,056,900
Bunkers	10,488,900	4,719,200	4,388,700
Coke exported ...	2,327,000	497,000	72,400

Price of Coal

The Coal Act as it stands at present requires the N.C.B. "to produce coal in such qualities and at such prices as seems best calculated to further the public interest in all respects."

As the Chairman of the Industrial Coal Consumer's Council, Sir Ernest Smith, truly said when addressing the National Coal Board's Summer School on August 25th last, price and quality are the factors which would have a deciding influence on the state of British trade in the not too distant future.

The present price of coal is very high and the quality not what it was and what it should be. The price was increased by 4s. a ton on September 1, 1947, and again by 2s. 6d. a ton on January 1, 1948, so that the average proceeds for the last quarter of 1947 had reached the very high level of 42s. 10·7d., against a cost of 43s. 8·4d, or a loss of 9·7d. per ton, and for the third quarter of 1948, 47s. 8·1d. against a cost of 46s. 2·2d. per ton.

The increase of 6s. 6d. per ton in the price throws, it has been stated, on industrial and domestic consumers an added financial burden at the rate of £60 million a year. The adverse effect on commerce of the present high price of coal is evidenced by an order made by Mr. Strauss, the Minister of Supply, which took effect on August 23rd last, whereby the maximum prices of iron and steel were increased mainly to offset the rise in coal charges, the principal increases concerning pig iron, heavy steel products, alloy steel billets, rods and silico-manganese billets, which in the main will be borne by the heavy engineering industry.

This must result in the enhancement in the price of other products resulting therefrom. The two nationalised industries, coal mining and railways, will suffer by having to meet an increase in cost by reason of 3s. 6d. per ton for the production of steel mine supports (props and arches), and for heavy rails—and so the vicious circle works. Well might Mr. Alfred Robens, Parliamentary Secretary to the Ministry of Fuel and Power, say, speaking on August 23rd last, at the opening of the National Coal Board's Summer School at Oxford: "The coal industry cannot look upon the consumer as a milch cow, and merely go on increasing the price of coal to cover extra costs. The policy is indefensible. The aim must be to cheapen coal or we shall find the cost of our manufactured goods for home and export beyond the reach of the purchaser and we shall be on the road to ruin."

According to the N.C.B.'s annual report, the price structure of coal is under review, but this review may not be completed before the end of the year 1948. By flat-rate price increases the price structure has been so distorted as to make the cost of the poorer qualities relatively much dearer than the better qualities. This, we understand, is to be changed. The price of coal, taking as a basis the year 1930 at 100, has varied as follows:—

	Index figure
1938	123·2
1946	244·0
1947	251·7

The Report of the N.C.B.

An important event in the year's record was the issue on July 13th of the first annual report and statement of accounts for the year ended December 31, 1947, by the National Coal Board. This voluminous document, of over 80,000 words, though of much interest, it must be confessed is a disappointing report. For though the mines produced 186,351,900 tons of coal or 6 million tons more than in the previous year, and in addition 10,235,200 tons from opencast workings, production fell short of the 200 million tons target set up by the Government in February, 1947. The cost of production, too, was 4s. 3·1d. per ton more than in 1946, and, whereas in the year 1946—the last year in which the mines were worked under private enterprise,—a profit of 1s. 11·3d. was earned there was a loss of 1s. a ton, or £9 million, for 1947. The difference between 1946 and, 1947 was made up thus:

	s.	d.
Increase in costs	4	3·1
Increase in proceeds (selling price was increased by 4s. per ton in September, 1947)	1	3·8
	2	11·3

So much for the loss on the collieries.

There was earned a profit of £3,016,605 from auxiliary undertakings—coke ovens, &c., which brought the total loss from collieries plus ancillary undertakings to £6,187,300. The other transactions of the Board resulted in a loss of £17,068,286, e.g., loss on imported coal, compensation for loss of office, interest and interim income payable, bringing the total loss up to £23,255,586.

As the collieries are now owned by the nation, royalties, rents and wayleaves, which used to be payable to the Coal Commission, and which amounted to about 5s. 0¼d. per ton, are no longer paid, but have been replaced by a provision for amortisation of the value of the minerals. It would be interesting to learn on what basis this is being effected.

Working Results During 1948

It is too early yet to assess the full result of the past year's working of the collieries, but the figures for the first three quarters have been published. For the first quarter a profit of £3,816,154, equal to 1s. 6·8d. per ton, was earned; but it must be borne in mind when entering upon comparisons with the previous year that the proceeds were higher in the later period by the increase of 2s. 6d. per ton introduced on January 1, 1948.

For the second quarter a profit of £4,432,828 was obtained, equal to 1s. 9·6d. per ton of saleable coal, but the larger profit, as compared with the previous quarter, was due to a further advance in the average proceeds per ton, i.e., from 46s. 3·5d. in the first quarter to 47s. 1·9d. per ton in the second quarter. After the payment of interest and interim income, the surpluses were, respectively, £601,154 and £1,002,828.

The results for the third quarter, which were published on December 7th, show a deficit amounting to £372,943 after making allowances for interim income payable to the Minister of Fuel and Power, but the collieries made a profit of £3,417,057 and there was a further income of £150,000 from ancillaries plus £110,000 from investments and royalties, and, as has been already stated, proceeds per ton were 47s. 8·1d. per ton.

Having regard to all available facts, it seems doubtful whether the 200,000,000 tons of deep-mined coal for the completed year will have been reached, or that a profit will have been earned, in spite of the pithead price of domestic coal having been increased by 6s. 6d. a ton, as compared with that ruling during the first three quarters of 1947, and of an increase of 25s. per ton in the price of exported coal.

Prospect of an Enhancement in the Export of Coal

We have promised, under the European Recovery Programme, to export 21½ million tons of coal to the Continent in 1949, and it is projected to increase coal exports as a whole to 25,000,000 tons. But in order to carry this into effect the output target will have to be considerably advanced, since fully to satisfy our home needs alone will require 200 million tons. It seems doubtful, judging from the present outlook, whether the output for 1949 will much exceed 207½ million tons. Poland will be a potential competitor, with a price lower than that of our coal; the Ruhr coal production, too, is capable of a great increase in a very short time, and our grip on the mines of the latter will shortly be released. Will not the price of exported British coal have before long to be brought into accordance with a European competitive price—assuming that a European production and sales plan is devised

by O.E.E.C. in Paris within the next four years? These are matters for consideration.

Persons Employed: Earnings of Miners, Hours of Work and Disputes

The average earnings per manshift of the miners—men, boys, and women (the last-named only employed on the surface and chiefly so in Lancashire) were, for the second quarter of 1948, as follows:—

	Underground		Surface		All workers	
	s.	d.	s.	d.	s.	d.
Cash earnings	34	1·4	23	0·9	31	5·5
Value of allowances in kind	1	4·3	1	1·8	1	3·7
Total	35	5·7	24	2·7	32	9·2

The average weekly earnings were, respectively, £8 15s. 1d., £6 11s. 1d., and £8 5s. 2d. They fell slightly during the third quarter of the year.

A pit-by-pit survey made by the N.C.B. would seem to point to the total number of persons employed at the collieries by the end of 1948 being at the most not more than 727,000, with 297,000 of these employed at the coal face. By the end of 1949 the figures would be 736,000 and 310,000, respectively. The number of workers which it is possible to engage at the coal face is, of course, governed by the extent of the "face-room" available.

To grant income tax relief—for example, in respect of P.A.Y.E.—to the miners as an inducement to work more regularly, as has been suggested in some quarters, would be grossly unfair to those engaged in work other than in the coal mines, however arduous and important the work of coal-getting may be.

The agreement whereby, alternatively, either an extra half-hour be worked each day or extra shifts on Saturdays—the latter being preferred by most of the miners, is to continue in operation until April 30, 1949. The executive committee of the National Union of Mine Workers, on February 20, 1948, decided accordingly. The Saturday shift has not proved a success owing to the excessive absenteeism on that day. The hours of employment of the underground workers are seven and a half hours, exclusive of the winding time, and, as has been pointed out in the press, with overtime, will probably work out to 42·1 hours of work per week, or, with no overtime, to forty hours.

A bright feature of the past year was the comparative freedom from disputes which characterised the industry. A few threatened strikes have been avoided by settlement in advance; a very different state of affairs from the preceding year, when actually more days of work were lost from trade disputes than in three out of the five years, 1935–1939, when the number of men employed at the pits was considerably greater.

Absenteeism and Output per Man

It was hoped that the concession of the five-day week would result in a marked reduction of abstention from work on the part of the miners, but that result has not been achieved, for voluntary absenteeism has continued to be very high and shows little signs of diminution. The average for the year is not yet available but taking, for comparative purposes, the weeks ended July 24th and July 31, 1948, and comparing these with the week ended August 2, 1947, the absentee percentages are tabulated below.

In this connection one wonders how the figure for involuntary absenteeism is arrived at. Presumably, from returns from each of the collieries, but if this is so, the above figure in respect thereof seems to be on the high side. For, if correct, the figure recorded for the year 1938 for the total average absenteeism, voluntary plus involuntary, 6·44 per cent, is a remarkable example of what the miners of the United Kingdom can do, showing, as it would, on a comparative basis, that there was little more than 1 per cent of voluntary absenteeism from work during that year—if the involuntary absenteeism was as high as, say, 5·34 per cent. The Coal Mining Organisation Committee, which reported to the Home Secretary in 1915, stated: "From a study of all the figures before us and from the evidence we

Absenteeism

Week ended	July 24th, 1948	July 31st, 1948	August 2nd, 1947
Face Workers			
Voluntary	8·54	11·82	8·80
Involuntary	6·18	6·59	6·38
Total	14·72	18·41	15·18
All Workers			
Voluntary	6·43	8·62	6·81
Involuntary	5·29	5·54	5·34
Total	11·72	14·16	12·15

have taken on the question, we have arrived at the conclusion that 5 per cent is a liberal allowance to make over all classes of mine labour, surface and underground, for absence from work for sickness, injury and other unavoidable causes." Various reasons are advanced to account for the present high rate of absenteeism, such as the high rate of wages at present ruling, the imposition of P.A.Y.E. income tax deduction, the absence of opportunity for expenditure, and underfeeding.

It is a fact, as experience over a long period has shown, that in the past, when high rates of wages have ruled, absenteeism has been highest, and that it is not the older men who are more liable to abstain from work, but the younger and more able-bodied. It is certain, too, that abstention from work is highest amongst the face workers, by whom the most arduous work in the mine is performed. A reduction in absenteeism to the 1938 figure would result in the augmentation of the annual output by, at the very least, 12,000,000 tons. As Mr. Cyril Osborne, M.P., said in a letter to *The Times*, on August 27th last, writing on the nationalisation of the industry, "The real justification was not technical necessity, but the sincere belief that the miner would work more willingly and more effectually for a nationally owned industry than he would for private profit." But this hope, as we see, has not been borne out in fact.

As has been stated, the average absenteeism for 1938 was 6·44 per cent. The average now, ten years later, is nearly 11 per cent. In the meantime the average output per manshift has fallen from 1·14 tons to 1·11 tons over all, and from 3 tons to about 2·9 tons at the face. In a speech of sound advice made by the Minister of Fuel and Power at the Northumberland Miners Demonstration on November 20th, he warned the miners that the benefits gained by them could not be sustained unless there was a better attendance at the pits.

Sir Charles Reid, when a member of the N.C.B., stated in Edinburgh, on April 17th last, "It does not matter what we do, output per man has not risen and is not rising." Mr. G. E. Aeron-Thomas, Chairman of the South Western Division of the National Coal Board, than whom not many have such a wide and intimate knowledge of anthracite mining conditions in South Wales, in a forthright statement made at Swansea on November 12th last, said that the position of the anthracite area was most serious. A section of the men in that area was definitely pulling the whole show down, he continued. It had been made clear that unless productive effort on the part of the miners was forthcoming, the only alternative was a lingering death of the anthracite area. The Board could not go on working collieries at a loss, desperate though the need of coal might be.

(*To be continued*)

Obituary

SIR MALCOLM CAMPBELL

It is with deep regret that we have to record the death, which occurred at his home, Reigate, Surrey, on the eve of the New Year, of Sir Malcolm Campbell, whose determined efforts gained for him both the land and the speed records for England. He died at the comparatively early age of sixty-three.

Malcolm Campbell was the son of William Campbell, of Chislehurst, and was born in 1885. He received his education at Uppingham School, and then spent some time in France and Germany.

On coming of age, he became an underwriter at Lloyd's, but his real interest was from the first in motor cars, motor racing and flying. He built his own monoplane in 1909, and the following year he began his long career as a driver of racing cars. At the outbreak of the first World War he served in the Army and the Royal Flying Corps, and he also served in the second World War.

He drove many racing cars on the Brooklands racing track, and in 1922, with a 350 b.h.p. Sunbeam car he reached a speed of 135 m.p.h. Later he raised that record to 150·87 m.p.h. on Pendine Sands. Then followed some years of rivalry with the late Sir Henry Segrave, in which both racing men in turn set up new speed records. Between 1924 and 1926 Sir Malcolm, at his own expense, built a special car with a 450 b.h.p. Napier "Lion" aero-engine. Later, with redesigned cars and more powerful Napier engines, he gained new successes, and in February, 1931, he made a record of 246·09 m.p.h. for the flying kilometre on Daytona Beach, and the next day with an Austin "Seven" car broke the class record at a speed of 96·06 m.p.h. On his return to England, he received a knighthood.

In 1933 he was awarded the Segrave Trophy. In that year he raised his record speed to 272 m.p.h., and two years later to 276 m.p.h. on Daytona Beach. On the Bonneville salt flats in Utah in September, 1935, he achieved a new record of 301·13 m.p.h. He then decided not to contest that record unless it was beaten by a foreigner. It was, however, later beaten by Captain George Eyston and John Cobb.

About 1936 Sir Malcolm turned his attention to gaining speed records with motor-boats, and in 1937 in a boat designed by Mr. F. Cooper, and powered with a Rolls-Royce aero-engine, he attained a speed at Lake Maggiore of 129·5 m.p.h. Later, in a boat of improved hull design, he raised the record to 130·86 m.p.h. on Lake Halliwell. He then ordered a new "Bluebird," designed by Vosper, Ltd., with a Rolls-Royce engine, and obtained a speed of 141·7 m.p.h. on Coniston Water just before the war. It still remains the water speed record. He will be long remembered with gratitude and admiration by the many friends and firms with whom he worked, often spending his own money freely, for the pure joy of attaining new speed records for England.

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NOTICE TO READERS

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A RETROSPECT

HISTORIANS of the future looking back to the year 1948 will no doubt see it as though from a vantage point. Detail may, indeed, be hidden from them by the mists of time. But those happenings of the year, which were pregnant with meaning for the future, will stand out as sharply defined from the ruck of everyday events as steeples above surrounding roofs. But we, contemporaries of the very events we have to record, have no such advantage. More particularly in contemplating such a year as 1948, we feel at a loss, confused by multiplicity of detail. For though it is true that there was one event of certain historic importance—the acceptance by the American people of the proposals of the Marshall plan—and there was another—the presentation of the Iron and Steel Bill before Parliament—of great interest to the people of this country, the first had, in fact, little immediate influence upon events in Britain during the year under review, and a decision upon the second cannot be expected until 1950. Little else so especially remarkable to engineers as positively to demand attention occurred. For the most part there is only to be seen upon a backward view a mass of detail, interesting, certainly, but lacking form and difficult to digest.

Yet, looking back still further, it can be discerned that the comparative serenity of 1948 was as naturally the sequel to the storms of 1947 as the growth of a seedling into a tree is the outcome of careful tending. Now that we can be wise after the event, it is easy enough to realise that in 1946, the first full post-war year, optimism ran riot. In relief from the strain of war men in every walk of life, not least engineers amongst them, looked forward, with a wholly mistaken confidence, to an early relaxation of those controls and restrictions that war conditions necessarily impose and the realisation of those wonderful plans for a better world that they had drawn up whilst bombs still fell and shells still screamed. But fate always holds in store a rude awakening for those who dream idle dreams, however fine! In 1947 that awakening came for the people of Britain. It took the form of a fuel crisis in the spring, followed by a longer-drawn-out though less easily comprehended agony of a "dollar" crisis in the summer. Those two disasters were the paramount events of 1947. Government and people alike were made to realise that prosperity and high living standards were not to be realised as simply as they had hoped. It is, then, in the light provided by those antecedent events that we must look back upon the apparently quieter occurrences of 1948. The fact, indeed, that there were in 1948 no happenings that can be compared in dramatic effect with the disasters of 1947 is something for which we may be profoundly thankful. May we not also assume, with some justification, that the lessons of those disasters must have been well learned and that the British people began last year a serious effort to save themselves by their own exertions? For it is a mere common mistake of historians to suppose that it is the more obviously prominent events that shape the future. When least appears to be happening often the most is in fact being done. The apparent quiet of 1948, as engineers well know and as the statistics of production prove, concealed the fact of very great activity.

NUCLEAR POWER AND THE GAS TURBINE

Curiously, the deceptive air of serenity, succeeding a storm, that pervaded the whole economy of the country during 1948 enshrouded also the technical side. In 1946 and 1947 engineers were excited by revelations of the technical developments hitherto kept secret that had occurred during the war. Many of those developments seemed adaptable to the purposes of peace. There was, for instance, nuclear power as demonstrated by atom bombs dropped upon Japan and Bikini. Since means could be imagined for bringing this source of energy under control the age of nuclear power generation seemed no more than just around the corner. Similarly the gas turbine had proved itself to be serviceable for the propulsion of high-speed aircraft and so much had been learned technically in that application that its rapid further development for use in locomotives, ships and land power plants seemed probable. There were, too, other, only less exciting developments, with obvious peace-time applications. But just as the country as a whole had to learn that prosperity was not to be had merely for the asking, engineers discovered that the application of such new developments was not going to be as simple as at first it seemed. Their theories could be and were, in fact, worked out in considerable detail. But the practical difficulties could only be learned through hard experience. In 1948 it became more obvious than ever that any considerable use of nuclear power is unlikely for several years to come. Many practical problems have yet to be solved before a power plant larger in size than an experimental unit can be built and it still remains dubious whether the construction of a full-size base-load station would be economically justified. As for the industrial gas turbine, to the first fine careless rapture with which firms in this country took up its manufacture there succeeded during the year—if we may judge by the fact that the installation of not one single industrial plant seems to have been begun—a mood of greater realism. The aircraft gas turbine, a relatively simple machine, is already an established success. But in plants intended to operate at the high efficiency demanded by ships' engines and land power plants, and having also lives to be reckoned in hundreds of thousands of hours rather than mere thousands, there are still many problems for which satisfactory solutions remain to be found. The belief of theorists in this device has still to be proved by practical experience and it may well be that the faith of certain less resolute protagonists was already on the wane in 1948, assured though that prime mover eventually appears to be of success in certain applications in the future.

THE ECONOMIC BACKGROUND

Alas! In one sense 1948 differed little from 1947. Some time in the future—may it be not long delayed!—we shall, when composing a Retrospect for another New Year's number, be able to eschew all but a passing reference to economics, that dry and usually gloomy subject. But, unfortunately, it is impossible to neglect the study when looking back upon the events of 1948. For economic forces, which always exert an influence upon the doings of men, though often a hidden one, were as obviously at work during the year as they had been in 1946 and 1947.

As a direct consequence of the unexpectedly rapid dissipation of the dollar loan granted to this country by America in 1946, and its virtual disappearance by midsummer, 1947, the Government, as was obviously its duty, set out in the autumn of the latter year and the early months of 1948, to lay before the people more plainly than before the unpalatable facts about their country's plight. A whole series of White Papers painted the gloomy picture. That on "Capital Investment in 1948" issued in December, 1947, long before the coming of "Marshall" aid could be relied upon with certainty, showed that, so great was the country's need to increase its exports, we could no longer afford to devote to the production of capital goods so large a proportion as before of raw materials such as coal and steel that were in short supply. An economy of some £180,000,000 upon this account was envisaged at that time, although in fact it is probable that the

economy actually realised in 1948 was smaller. Another White Paper on "United Kingdom Balance of Payments, 1946 and 1947," revealed how very greatly the country's resources of credit overseas had been drawn upon, how low was the reserve still remaining and how impossible it was that so heavy a draft upon what remained could be borne in the future. The "Economic Survey for 1948," whose publication was delayed until March, like its predecessor of 1947, laid down in very broad outline the plans of the Government for the year and amongst other matters set new and stiffer targets for the export performances of various industries. Those three documents, between them, demonstrated, generally, how austere life in Britain must remain throughout 1948 if it was to survive its economic troubles. But it was reserved to a "Statement on Personal Incomes, Costs and Prices," made by Mr. Attlee before the House of Commons in February, and subsequently published as an appendix to the "Economic Survey for 1948," to bring right home to every individual how that austerity must affect him, how "there should be no further general increase in the level of personal incomes without at least a corresponding increase in the volume of production," and how "if general increases in profits, salaries or wages take place without more goods being made available no one can obtain any real benefit except the black market operator." Late in the year there was further issued a memorandum on "European Co-operation," explaining the long-term programme of the United Kingdom. It revealed that austerity conditions are likely to rule at least until the year 1952. It is not our purpose further to discuss these documents here. For, as a consequence of their issue and of explanatory speeches by members of the Government, economists, industrialists and even trade union leaders, there was created an atmosphere of which almost every inhabitant of this country must have become conscious by the end of the year. It remains only to remark that by December, through the work of its people and more particularly of engineers in helping to raise the level of production, Britain's economic situation was very substantially more promising. A deficit in the country's account with the Western hemisphere, which can only be balanced by recourse to Marshall aid certainly remains. But it does not seem wholly unreasonable to hope that upon the remainder of the account a balance was attained.

Productivity

Every index bore witness during the year to the fact that this country was producing more than it had ever produced before. Steel production by the end of the year was running at a rate of about 15,750,000 tons per annum, a record figure. Coal production, it is true, was substantially below pre-war figures. But the amount consumed at home was running at about 192 million tons per year, compared with 180 million tons in 1938. The capacity of electricity generating stations as a result of extensions to old and the erection of new power stations reached over 13,000,000kW by the end of the year. Though about 39 per cent above the 1938 figure it yet proved inadequate to meet the peak demand. But despite the high production to which such figures bear witness, the country was still not producing enough to pay by way of exports for essential imports and at the same time make adequate provision for the home market. The need to expand output continued through 1948 and will continue throughout the present year. But, in 1948, the effort to raise total production began to take on a new orientation. In 1946 and again in 1947 it had been quite reasonable to calculate confidently upon a steadily rising yield from industry as the direct consequence of the return of men demobilised from the Forces and their gradual recovery of their old dexterity and skill. But during 1948 the strength of the labour force approached its peak. The numbers in civilian employment and working upon the production of munitions reached 18,933,000 in March, 1948. By October there had been a further apparent gain to 19,209,000. But these comparative figures cannot be wholly trusted. For as the year grew older, the need was felt to divert more labour to the manufacture of munitions, against the increasing, and at one time apparently imminent, risk of renewed war. How many are so employed it is not now possible to say. But that the number was greater at the end of the year than it was in the spring can hardly be doubted. Moreover, as a consequence of the increase in the period of national service for youths to eighteen instead of twelve months, as decided upon towards the end of the year, it can be foreseen that the amount of labour available for civilian production is more likely to decrease then increase in the present year.

Hence, during 1948, emphasis began to be laid by the Government more and more urgently upon the need to enhance productivity per head of the labour force. In no other way, save only through increased hours of work, which trade union leaders would not tolerate, could a further improvement of total output be attained. It thus became the policy of the Government to criticise managerial methods in this country and to suggest that if the standards of better managed concerns could be reached by those less efficiently run output could be very much improved. In April, sponsored by the Government, the British Institute of Management was inaugurated. Its object is to further the exchange of knowledge about managerial methods in the hopes that through more efficient management output can be increased and costs reduced. Further, somewhat over-impressed, we think, by that high productivity per head that certainly rules in many American industries and which is fostered by conditions that equally certainly do not rule as generally in this country, the Government turned to the U.S.A. for help and set up the Anglo-American Council on Productivity to encourage the exchange across the Atlantic of knowledge about production problems. Later, amongst other bodies created during the year, it set up a Committee for the Standardisation of Engineering Products, rightly believing that if the variety of sizes and types of products made in British factories could be reduced and methods for standardising components and sub-assemblies could be devised, methods of production new to this country might economically be justified. The full consequences of these actions remain to be noticed as the years still ahead come to be reviewed. But we cannot resist the temptation to comment that the success or failure of the Government's efforts to raise productivity will depend ultimately on the skill and ingenuity of individual engineering firms and individual engineers. Fortunately, the enhancement of productivity always has been and always will be one of the main objects of engineers, the necessary consequence of their constant keen desire to improve the designs of their structures and their machines. Whether or not the new bodies set up by the Government prove useful to them in doing such work we can have no doubts that the productivity at least of engineering works in this country will improve as the months pass. The very fact that many such new factory buildings as those we illustrate in one of the pages of our Supplement were completed, were under construction, or had been planned in detail in 1948, is proof enough that engineers are well aware of present deficiencies in factory lay-outs and productive methods and determined to improve upon them.

Labour

In recent years trade unionism in this country has worn a double face. One face, influenced by the opinions of individuals on the factory floor, each fearful of unemployment or of "exploitation," each desirous of shorter hours and higher wages, remains, as of yore, suspicious of managerial intentions, often restrictive in outlook towards new methods of production, sometimes frankly hostile, and always more narrowly conscious of immediate ills than of longer term benefits. But the other face wears a fairer aspect. The leaders of the T.U.C. having the interests of a large part of the working-class population at heart are compelled to have broader views. Of necessity, since the war, they have become more impressed by the benefits conferred upon the community as a whole through increases in the rate of national production than by the risk that a few may suffer thereby from temporary unemployment. When times are bad and unemployment is rampant, as it was between the wars, the narrower view prevails. But when labour is in short supply as it was during 1948, the leaders of trade unionism can venture to express their views. Thus the interest shown by the unions and their executives in co-operating upon higher and lower levels with managements in studying methods of raising productivity indicated a change of heart less revolutionary than it appeared at first sight. It amounted, in fact, to no more than the adoption of a policy recommended by Lord Citrine as long ago as the "twenties." Much more really surprising was the policy adopted by the T.U.C. in relation to wage claims. In 1947 it had expressed very decided opposition to a remark in the "Economic Survey" for that year that "the nation cannot afford shorter hours of work unless they can be shown to increase output per man-year." The appeal of Sir Stafford

Cripps, "In the long run we should look to the raising of our standards of living along the lines of reduced prices and stable wages rather than on the lines of ever-increasing wages and prices and, so far as experience goes, prices always winning," fell, too, on deaf ears. For a time of labour shortage, such as has ruled since the war ended, is naturally and traditionally one favourable to the success of wage claims. But, given time, the arguments of economics, which cannot be gainsaid, prove very forceful. Early in 1948 the T.U.C. was driven to admit their strength. Albeit grudgingly and with certain reservations about claims already pending it felt itself compelled to accept the implications of Mr. Attlee's "Statement on Personal Incomes, Costs and Prices." Its leaders and a majority of its delegates agreed that wages should be "frozen" at existing levels provided that distributed profits from industry were similarly frozen and that an attempt was made to bring prices down.

But it would be altogether too much to expect that rosy dreams of complete concord between managements and men aroused by the actions of the T.U.C. should come wholly true! In fact, they did not. Trade unionism, as we have already remarked, is two-faced. While the T.U.C. was thinking in terms of co-operation with managements in raising productivity and could even go so far as to suggest that jealous competing unions ought sometimes to agree to transfers of members in order to assist the output drive—a quite daring pronouncement upon a particularly thorny subject—many things were still being done by junior executives to impede production; and at least one strike—an unofficial one in the London docks against the use of a labour-saving machine—gave living breath to the very spirit of the nineteenth century Luddites in expressing dread of improved working methods. Nor in the "freezing" of wages did performance come very creditably near to promise. During the whole of 1947 increases of weekly wages amounting in the aggregate to £1,726,500 were granted to 4,942,000 people. During the first eleven months of 1948, despite any influence the "Statement on Personal Incomes, Costs and Prices" may have had—the figure must surely make the reader doubt whether in reality it exerted any!—increases of weekly wages granted to 7,585,500 people amounted to the larger figure of £1,849,300. Moreover, as the year ran to its close, busmen in London were deciding upon "unofficial" strike action for extra pay on Saturdays, and railwaymen, supported by their union, gave statutory notice to the Minister of Labour of a dispute over wage rates.

Nationalisation

Nowadays, we understand, the teaching of the very young has been much improved. But in our day it was the object of a teacher, as almost a moral duty, to put certain simple facts before the simple, childish mind. In history lessons, for instance, we were taught that such a one as Alfred was "a good king," and such another as Charles II was "a bad king." It is astonishingly difficult now, despite a much more detailed knowledge of the characters concerned, to throw off the strong influence of those children's lessons. So, perhaps, we ought to deal tenderly with the belief clearly held by many Socialists, as apparently an article of unchallengeable faith, that the nationalisation of an industry must benefit both the industry itself and the community. No doubt they were taught in early youth that nationalised industry was "a good thing" and private industry "a bad thing"! It is difficult in any other way to account for the desire, strong amongst Left-Wing Socialists, to see the iron and steel industry nationalised under the Iron and Steel Bill presented to Parliament in November. For certain other nationalising measures cases not lacking in a certain strength could be built up as, for instance, that without transfer to public ownership the miners would never be satisfied and new recruits would not be drawn to an industry producing a vital raw material; that it had been found necessary to generate electricity nationally when the grid was formed and that much of its distribution had long been in public hands; and that so much economy had been achieved by the grouping of the railways in 1923, that further economy might well be expected as a consequence of unifying the whole system. But there is no such argument that can sustain the proposal to nationalise the iron and steel industry. Every thinking critic in the dying months of the year was able to tear the clauses of the measure to pieces. But the fate of the measure still remains to be decided, this year or next, by the choice of an electorate which unfortunately cannot have any real understanding of the issues involved.

Miscellany

There is much else to which we might have referred and which we ought perhaps to have discussed in this Retrospect. The performance of the nationalised coal industry, for instance, did little to support the Socialist idea that mere nationalisation in itself is a cure for many ills. The output of coal from the mines failed by over two million tons to reach the target set for the year, the industry did not attract by a very considerable margin the number of recruits it required, and the chance that enough coal can be raised during 1949 to permit the export of 25 million tons in that year without starving home industry seems slender. The situation of the coal industry is fully discussed by Sir Richard Redmayne on other pages of this issue. Amongst other matters to which we might have made longer reference had space allowed was that remarkable show of machine tools organised by the Machine Tool Trades Association at Olympia in September. It demonstrated that, despite the high rate of demand ruling for the delivery of "standard" machines, makers in this country are fully alive to and taking a big hand in furthering development. There was, too, the Berlin air-lift—an affair of which aeronautical engineers may well be proud. . . . But we must hasten to our final paragraph.

Food and Engineers

This is a "Retrospect." It looks back at and considers the work of the year just gone. But we should look back—should we not?—with thoughts of the future rather than of the past. Do we not wish to see what we have already done that we may the better see what there is still to do? Moreover, can we not as a New Year begins let our eyes rove more widely than at other seasons? May we not lift them for a while to view not just the immediate tasks that lie ahead but what we need to accomplish over a wider span of years? For in 1948 there began to be built up before engineers a grand conception of a future purpose. We in this country exist upon short rations. But the food shortage is not confined to these islands. It is not a mere consequence of our economic difficulties. It is world-wide. The areas of the world under cultivation in 1948 were certainly no more extensive than they were before the war. But the world population increased by about seventeen million souls during that ten-year interval, and it continues to increase by at least one and a half million annually. Repeatedly during the year Sir John Boyd-Orr, amongst others, sounded a note of warning. Unless the food production of the world can soon be raised severe shortages must occur. Nor, as the difficulty this country is already experiencing in buying food demonstrates, can it necessarily be assumed that shortages will be confined to distant regions of the earth far from European shores.

In only one Continent, the "dark" undeveloped Continent of Africa, do there yet remain great areas of cultivable land still to be brought under the plough. But as the troubles encountered by those endeavouring to carry to completion the East African groundnuts scheme reveal, engineers have many problems still to solve before the agricultural development of Africa can be accomplished; and before much extra food can reach the world from that source there are great bridges, great roads and great railways to be built; harbours to be constructed; power to be developed and machinery of many kinds to be installed. Scientists also will be concerned. But the greater part of the work will be for engineers to do. Nor will the work be confined to Africa alone. There are other regions of the earth such as India and China in which the need is combined with the opportunity to irrigate deserts and build great roads and railways for the transport of crops. Yet "man cannot live by bread alone." More is needed. Standards of living in backward countries need to be raised so that their inhabitants may gain the leisure to learn, as populations can learn, and as Europeans have perhaps already learned too well, that expansion of population needs to be controlled. Only through the beneficent work of engineers in making power available all over the earth, power that can replace human and animal muscle and relieve man of toil, only the replacement of hand labour by machine labour, can lift standards sufficiently far. Expansion of food production in the future must, therefore go hand-in-hand with expansion of power production. One of the tasks of engineers in the future must be to bring to backward peoples the material benefits they have conferred on Western civilisation. If they fail the nightmare dreamed by Malthus may become a harsh reality!

Civil Engineering in 1948

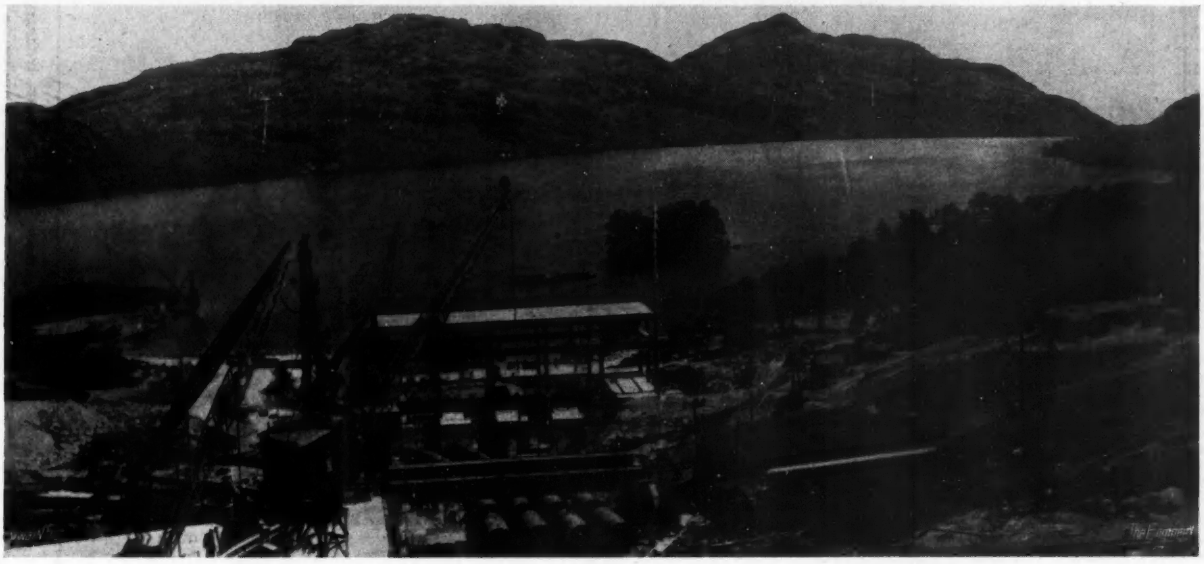
No. I

DURING 1948 civil engineers and contractors the world over worked at full pressure on an untold number of schemes, many of which had been long delayed in their starting by the upheaval of war. Yet, although more than three years of so-called peace have elapsed, difficulties of one sort or another caused by the war have prevented most major schemes showing more than nominal progress. The back-log of works urgently necessary to bring the standard of living in most countries somewhere near the level obtaining pre-war is still enormous. To meet to-day's demands, for example, for power alone is a gigantic task and is one in which the civil engineer's works are increasingly required.

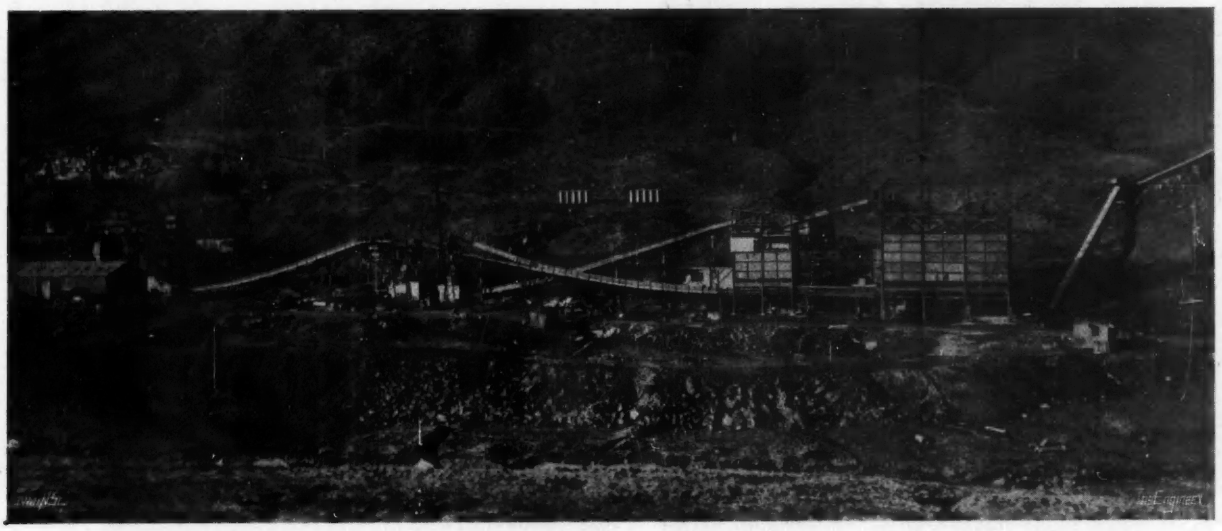
Unfortunately, the economic state of the world, no less than the scarcity of engineers and equipment, has set a limit upon the number of schemes and the type of work it has been found possible to authorise. Thus, for most people the first hopes of quick progress in the construction of highways, bridges, ports, aerodromes, fitted to present-day and future needs have been unfulfilled. They have realised that even modest post-war programmes have had to be cut down for lack of finance, men or material, and it is now plain that many years must pass before arrears can be overtaken, much less those new schemes started which would delight the heart of the civil engineer by giving mankind a better world than ever.

Now that the ravages of war have been to some extent repaired, the order of the day for 1948 has been concentration on the priorities of power supply and, in regions where new industries are to be established, the building of means of communication. Broad planning for the future seems to be complete. It remains to carry into effect the schemes which will make possible a great increase in industrial activity and world trade.

Thus it is no matter for surprise that civil engineering schemes in 1948 have been chiefly those connected with hydro-electric power generation. In fact, in compiling the review of civil engineering in 1948 which follows, it has seemed that hydro-electric schemes were the only schemes afoot! That is not so, of course, for the ordinary work of many civil engineers has gone on without being in the news. Such work is of a hum-drum nature and lies in the building of foundations, sewers, wharves and such like. Not for them the glory of a massive dam rising hundreds of feet and holding in check immense quantities of water!



LOCH SLOY PROJECT—POWER STATION AT INVERUGLAS ON LOCH LOMOND'S SHORE

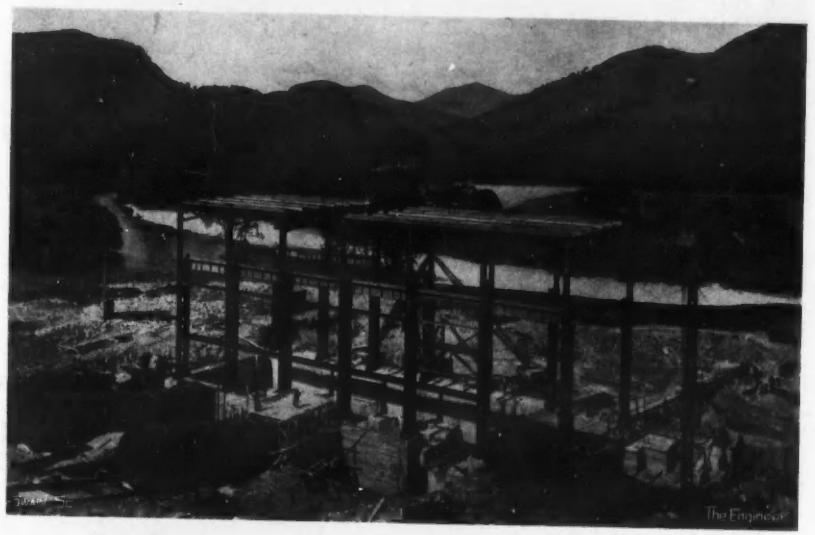


LOCH SLOY PROJECT—COIREGROGAIN QUARRY

Scottish Hydro-Electric Schemes

Though not to be compared in size with some of the Continental and American schemes, the projects of the North of Scotland

WORKS OF THE NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD



TUMMEL - GARRY PROJECT—CLUNIE POWER STATION
MORAR INTAKE AND GENERATING STATION, OPENED DECEMBER 21, 1948

LOCHALSH DAM, OPENED DECEMBER 21, 1948
MORAR FALLS AND REGULATING WEIR

Hydro-Electric Board are full of interest. On several of the larger schemes work is well ahead, whilst two of the smaller ones were completed and brought into service only a week or so ago.

TUMMEL-GARRY PROJECT—PITLOCHRY DAM AND POWER STATION

The Loch Sloy scheme is an important development and the works are in an advanced stage. One of our Supplement illustrations will next week show work in progress at the dam site, where about 200,000 cubic yards of concrete is being placed by a cableway. Loch Sloy dam is to be 160ft high and 1150ft long. It will hold up water in the loch to a gross head of 910ft above Loch Lomond, the site of a generating station to have an installed capacity of 130,000kW. The water will flow through a tunnel through Ben Vorlich nearly 2 miles long and 16ft in diameter to pipe-lines for the remaining 650ft gross head to the turbines on Loch Lomond's shore, at Inveruglas. An accompanying illustration gives a good impression of the generating station and the beauty of its setting.

The works, which include tunnels and aqueducts tapping small lochs and tributaries over a total catchment area of 32 square miles, were started three and a half years ago. Apart from the dam, tunnels, pipe-lines and generating stations, an important undertaking was the construction of Coiregrogain quarry, by Keir and Cawdor, Ltd. The plant at this quarry, having a capacity of up to 1500 tons per day of crushed aggregate for concrete, is illustrated herewith. It is situated about 1½ miles from the dam site, and material is carried by a belt conveyor over this distance.

In designing and carrying through the Loch Sloy project Messrs. James Williamson and Partners, Messrs. Kennedy and Donkin, and Mr. H. R. Tarbotton have been associated in respect of civil and mechanical engineering and architecture, respectively.

Good progress has also been made on the Tummel-Garry project, in Perthshire, which is to have an installed capacity of 147,000kW in three generating stations. At Pitlochry dam and power station, which is to have two Kaplan turbo-alternators with a combined capacity of 15,000kW, the stage reached is shown in two accompanying illustrations. The construction of reinforced concrete spirals for the turbines is in an advanced stage, and at the close of the year the point was being approached at which erection of the turbine house superstructure and overhead crane could be carried out. The right-hand half of the dam, with four temporary openings, has been brought high enough to allow the contractors to start turning the coffer dam, to lay bare the site of the left-hand half.

At Clunie dam, which will raise Loch Tummel by 18ft, a similar stage of progress had recently been reached. The Clunie tunnel, 8800ft long and 23ft equivalent diameter, to lead the waters to the Clunie power station, is more than half driven. Much of the bore had to be supported by steel centering where the rock was found to be shattered, and progress was held up by very hard white quartz rock in other parts, but the placing of the concrete lining is soon to be undertaken. The steel pipe trifurcation for the Clunie pipe-line is shown in an illustration, as made up at the works of P. and W. Maclellan, Ltd. It divides the water from the main 21ft 6in diameter pipe to three pipes each 12ft 3in in diameter, leading to three Francis turbo-alternators, aggregating 57,000kW. The Clunie power station steel framework under erection is shown in one of the illustrations on the opposite page. An overhead crane of 110 tons capacity has been installed and was recently in use for erecting the turbo-alternators. It is expected that one of the sets will be in operation by the end of 1949.

By the close of 1948 the piers and abutments of the new Aldour Bridge had been completed, and work on the spans was in progress. This bridge, a three-span reinforced concrete structure across the River Tummel just below Pitlochry, will replace Clunie

TUMMEL-GARRY PROJECT—CLUNIE PIPE-LINE TRIFURCATION

TUMMEL-GARRY PROJECT—PITLOCHRY DAM, TEMPLATE FOR STAY VANE BOLTS

bridge, which will eventually be submerged.

A further stage in the Tummel-Garry development was reached by the placing of the contract for the Errochty section of the work with A. M. Carmichael, Ltd. The Errochty station will have a capacity of 75,000kW and will be fed from a new loch in Glen Errochty through a tunnel 5 miles long. The head will be 610 feet.

The engineers for the Tummel-Garry scheme are Sir Alexander Gibb and Partners.

In Ross-shire, progress on the Fannich project continued, where the tunnel, which is to be 19,300ft long by 10ft equivalent diameter, is being driven from four faces. More than 8500ft has been driven, and work was started on a 220ft stope required in the construction of a 32½ft diameter surge chamber. No dam is at present required, as Loch Fannich can be drawn down 50ft. The installed capacity will be 24,000kW, generated by Francis turbo-alternators operating on a gross head of 537ft. Sir Alexander Gibb and Partners are the consulting engineers for this scheme.

The remaining large scheme under way is the Mullardoch-Fasnakyle-Affric project, situated partly in Ross shire and partly in Inverness-shire, for which Sir William Halcrow and Partners are consultants. The installed capacity will be 22,000kW. Work was started in the middle of 1947, but the first six months saw little but the carrying out of preliminary works. During 1948 the improvement of road access to the site of the works was completed and a temporary diesel generating station built to supply the works. Some progress was made on the permanent works, particularly on excavation for tunnels, for the Fasnakyle generating station and the Benevean and Mullardoch dams. The dams must be capable of passing very heavy floods and the design of their spillways was studied by means of models.

Two smaller schemes, as already mentioned, were notable for having been brought to completion in 1948, on December 21st. These schemes, Lochalsh and Morar, are part of the North of Scotland Hydro-electric Board's first "Constructional Scheme," the major section of which is the Loch Sloy project in Dumbartonshire. Illustrations on page 20 show the Lochalsh dam and Morar Falls and the generating station.

Lochalsh dam is 56ft high and 250ft long, across the Allt Gleann Udalain, and gives rise to a new loch in the hills about 500ft above Loch Alsh. A pipe-line 5230ft long leads to a generating station at Nostie bridge, which has an installed capacity of 1000kW. By extensions the capacity can ultimately be increased to 4000kW. At present there are two Gilkes 21in turbines, coupled to 500kW alternators. Sir William Halcrow and Partners were consultants for the civil engineering work.

Morar is the first underground generating station to be built in Great Britain. It has been built inside a cavern hewn from a knoll of solid rock beside the River Morar, so as to preserve the natural beauty of this well-known spot. It is a small undertaking, having at present an installed capacity of 600kW, but an ultimate development of 2000kW is planned, by raising the level of the loch by 9ft. At present the rise is only 3ft by an automatic regulating weir erected on concrete foundations in the river bed immediately above the Morar Falls. The work on the scheme included the erection of the weir, the building of the power station, the driving of short tunnels and the construction of a fish ladder. Consultants for the project were Messrs. J. and A. Leslie and Reid.

(To be continued)

Shipbuilding and Marine Engineering in 1948

No. 1

IN 1948 the shipbuilding and marine engineering industries of the United Kingdom had a busy if somewhat difficult year, in which over 1,200,000 gross tons of ships were completed. The shipyards and engine works were not working at full capacity, for they are equipped to deal with at least 1,700,000 gross tons yearly, when working at their highest economic rate. Shortages of steel and other basic materials, coupled with shorter working hours, tended to increase the length of time for both building and reconditioning work. The question of high costs remained a difficult and unsolved problem, alike for the shipowner and the shipbuilder, and increasing prices of steel, transport, coal and coke, and other materials were reflected in higher costs. On the other hand, it has often been pointed out that ships to-day, whether passenger liners or cargo vessels, are on the whole generally built for higher speeds, and modern propelling machinery is installed, while the furnishings and in particular the crew's quarters are better than those of pre-war ships. Such improvements, while increasing the costs, add value to the ship.

At the end of the last twelve months more than 2,000,000 gross tons of merchant shipping was on the berths or was fitting out. A feature of the year was the completion of several large liners specially designed and equipped for the services in the Atlantic, South African and Australian trades, some of which are illustrated in to-day's Supplement. Liner reconversion was almost completed during the past year, and several important ships again entered their owners' services. Indeed, it may be said that British shipbuilders have now enabled shipowners to recover their full capacity.

The Present Position

At the present time the orders on hand, which total about 2,500,000 gross tons, promise work for two or three years ahead. The principal class of ships ordered are oil tankers, for British and foreign use, the proportion of the total orders being nearly 37 per cent foreign tankers and 26 per cent British tankers, the remaining 37 per cent consisting of all other types of ships. The books show few orders for high-class passenger and cargo ships, and to balance output more orders are needed for tramp ships, colliers, and other similar vessels, such as coasting steamers and small motorships.

As we have already indicated, the industry is geared to produce a larger output of ships if sufficient steel is available. It has been estimated that a 50 per cent greater allocation of steel than at present would be needed to produce between 1,600,000 and 1,750,000 gross tons of ships per annum, and to use to the full the equipment of our shipyards and engine works, with increased economy and a possible lowering of building costs. Last year only about 1,000,000 tons of steel was delivered to the industry, and for 1949 a further 5 per cent only is promised.

The export value of British shipbuilding must be stressed. Of a total of £325,000,000 of tonnage building and still to be built, £110,000,000 is direct export work for the Dominions and for foreign owners.

British Shipbuilding Research

In the year under review considerable progress was recorded in the work of the British Shipbuilding Research Association. Under the leadership of its Council and its Director of Research, Dr. S. Livingston Smith, 1948 saw the full cycle of research realised, for many of the earlier problems and a number of new problems emerged. The nature of these early problems having been carefully studied and the research work on them planned and carried through, the results of that work were analysed. In the early part of 1948 work was begun on the preparation of research reports, and already nearly twenty of these reports are in the hands of the members of the Association. The research work done has also been referred to in scientific papers read before the Institutions, an example being the recent paper on "The Strength and Stiffness of Structural members," dealing with the research work carried out at Glengarnock, which was read before the North-East Coast Institution of Engineers and Shipbuilders.

The programme of the Association touches all sections of ship work connected with tank work, hull design and construction and machinery operation, and also the carrying out of sea trials. In a real sense the Association looks on the ship at sea as its working laboratory. In the machinery sections work has been started at the Royal Technical College, Glasgow, on the improvement of feed-water filtration and problems connected with water circulation. The reduction of noise in engine-rooms, particularly in motorships, has been further considered in collaboration with the Physics Division of the National Physical Laboratory. With that work is also combined a study of ventilation problems in machinery spaces and passenger and crew accommodation. A complete survey is being made of what are termed economical conditions in typical machinery spaces.

Work is being carried out on the life of cast iron, in conjunction with the British Cast Iron Research Association. The torsional fatigue testing of propeller and engine shafts is being continued by Lloyd's Register of Shipping Research Department for the Association. Vibration is being studied by making actual measurements both on trials and under actual operating conditions. On the hull side an important event of the year was the International Conference of Tank Superintendents, which at the invitation of Dr. Charles Darwin, F.R.S., took place during the summer months, many of the meetings being held at the home of the Association. These meetings revealed a general need for measuring the degree of turbulence in water, and for a detailed study of the characteristics of the friction belt, both in model and full-scale tests, attention being particularly paid to the extent of laminar flow, under various test conditions. This work links up with that of the Association's hydro-dynamic programme.

On the propeller side, many different aspects are being investigated, and on the structural side, in addition to strength and other tests made at Glengarnock, work on welded structures is being done in collaboration with the Admiralty Ship Welding Committee, and the British Welding Research Association. In connection with propelling machinery attention has been paid to steam pipe design for advanced steam conditions.

The *Journal* of the Association, which is published monthly, performs a most useful service by giving a full range of abstracts from current technical literature, both at home and abroad.

Liners of 1948

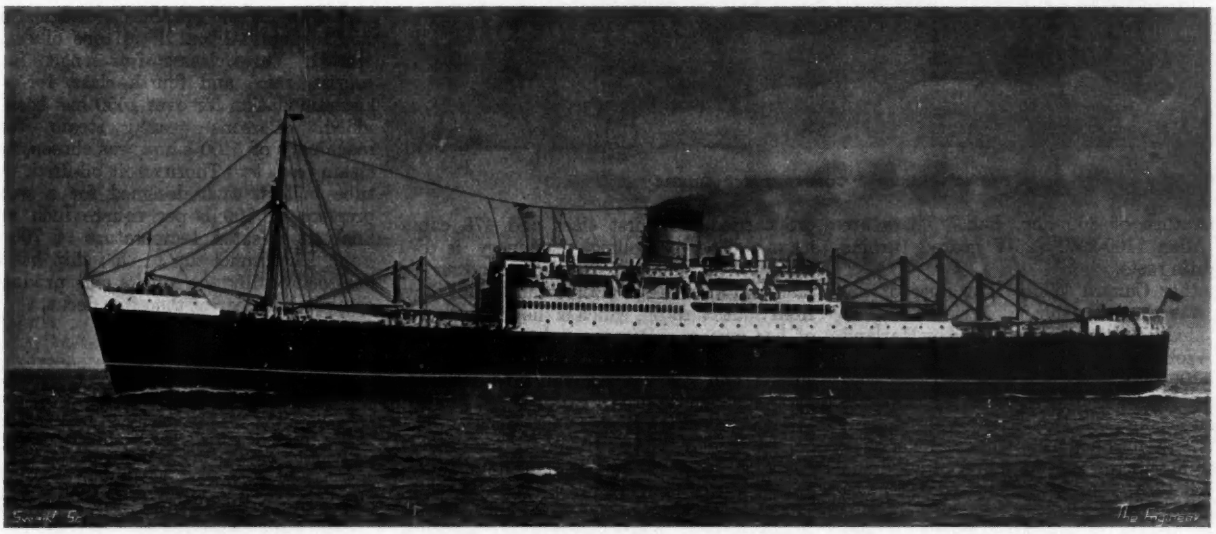
Although she was completed late in 1948, and only sailed on her maiden voyage from Southampton for New York via Cherbourg last Tuesday, January 4th, the Cunard White Star liner "Caronia," built and engined at Clydebank by John Brown and Co., Ltd., can be looked upon as the ship of the year, for she bears the distinction of being the largest liner to be built in the world since the war. While she was designed for the company's North Atlantic service, she is also attractive for cruising, and she is scheduled to make four cruises from New York to the West Indies in the early months of this year.

As our Supplement view indicates, the "Caronia" has a particularly pleasing appearance with her curved, well-raked stem, from which the main deck sweeps back to the terraced bridge structure. The mast is a tripod structure set abaft the bridge, the upper decks are free from ventilating cowls and isolated houses, and with broad terraces they descend to the stern. The single funnel is one of the largest of its kind built for a passenger liner, and it weighs with its uptakes and internal machinery 125 tons. Besides the uptakes from the four main and two auxiliary boilers it contains the induced draught fans and the wet dust collectors.

The keel of the "Caronia" was laid in February, 1946, and she was launched by H.R.H. Princess Elizabeth on October 30, 1947. A full account of the launching ceremony and the design and structure of the liner was given on that occasion in The Engineer. She has an overall length of 715ft and a beam of 91ft, with a depth moulded to the bulkhead "C" deck of 43ft 11in, and a measurement of 34,183 gross tons. The number of passengers she is designed to carry is 581 first class and 351 cabin class, which, with the 587 officers and crew, makes a total ship's complement of 1519 persons. There are ten decks, comprising the sports, sun, promenade, main "A" restaurant, "B," "C," "D" and "E" decks. There are thirteen public rooms, and two restaurants, named the Balmoral and the Sandringham, respectively. Views in the smoking room and the Balmoral restaurant are reproduced herewith. As befits her cruising duties, the "Caronia" is painted in shades of green, and aluminium paint is used for the deck machinery and fittings. The inside of the hull structure is sprayed with Newalls "Limpet" asbestos. Continuing the practice introduced with the "Queen Mary," the butts and laps of the shell plating below the waterline are faired with a special mixture of Aranbee composition in order to eliminate eddy-making at the plate edges.

The ship has been constructed to the highest class of Lloyd's Register of Shipping for the classification 100 A.1, with freeboard, and complies with the latest Ministry of Transport and international regulations for vessels carrying foreign-going passengers. Some 37,800 cubic feet of cargo hold capacity is available, some insulated. Cargo spaces are served by Laurence-Scott electric winches. Brown Brothers electro-hydraulic steering gear is fitted, with telemotor gear to the bridge, and the same firm supplied telemotor gear for operating the Tyfon whistles from the bridge. The navigation equipment was fully described in our launching article. An innovation in marine service is the use of single side-band telephony, and the receivers

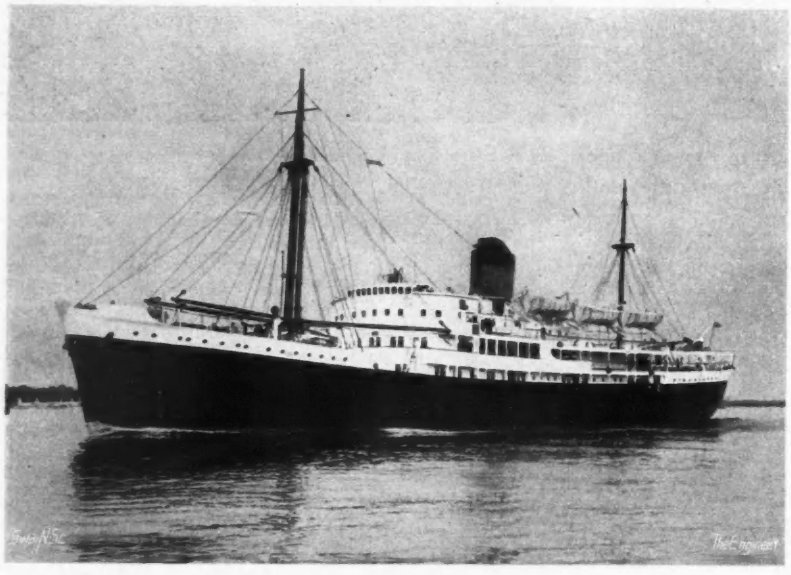
BALMORAL RESTAURANT AND FIRST CLASS SMOKING ROOM OF THE CUNARD WHITE STAR LINER "CARONIA"



CUNARD WHITE STAR LINER "PARTHIA"

and transmitters were supplied by the International Marine Radio Company to cover short, medium and long waves. The service telephones and loud-speaking telephones were supplied by the Telephone Manufacturing Company, Ltd., of London, and the manual and automatic systems by the General Electric Company, Ltd. Two radar systems are used, one the Admiralty No. 268, and the other the Metropolitan-Vickers "Seascan" system.

In this necessraily short review, we cannot describe in full the public rooms and cabins, and it will suffice to say that in design and artistic finish and decoration they more than maintain the very high standard of the owner and the shipbuilders, and we noted much original artistic work by several artists and firms. We shall deal with the propelling machinery more fully in a later article, but it may be said here that it consists of twin-screw Parsons impulse reaction geared turbines taking steam from four large and two smaller oil-fired Yarrow side-fired water-tube boilers, supplying steam at a pressure of 600 lb. per sq. in. and a final superheated temperature of 800 deg. Fah. There are four Allen 1100-kW, 225-V geared turbine generating sets.



FRENCH LINER "COMMANDANT QUERE"

Another Cunard White Star liner of the year was the "Parthia." A sister ship to the "Media," she was constructed by Harland and Wolff, Ltd., and entered service on April 10, 1948. She was designed and constructed under the supervision of Goodwin Hamilton and Adamson, Ltd., of Liverpool, and a description of the ship and her propelling machinery will be found in our issue of April 16th. She is designed to carry 250 passengers, and has proved, like the "Media," very popular in the company's North Atlantic service between Liverpool and New York. The liner has a length of 531ft 4¾in, with a breadth moulded of 70ft, a loaded draught of 30ft 2¼in, and a measurement of about 13,340 gross tons. She is designed to carry over 422,000 cubic feet of general and insulated cargo. Her main propelling machinery consists of twin-screw Parsons geared steam turbines designed for a service power of about 13,700 s.h.p., taking steam from two Foster Wheeler controlled-superheat, oil-fired, water-tube boilers, supplying steam at a pressure of 430 lb at the superheater outlet and a temperature of 750 deg. Fah. Four Atlas-Polar oil engine-driven generators supply the current for the ship.

The Union Castle Mail Steamship Company took delivery from Harland and Wolff, Ltd., during the year of two outstanding ships, the "Pretoria Castle" and the "Edinburgh Castle," the latter entering the owner's service towards the end of the year. Our Supplement illustration clearly shows that these liners have an attractive appearance, and they embody innovations in hull design and equipment, passenger accommodation and propelling and auxiliary machinery. A full description of the "Pretoria Castle" and her machinery was given in three articles in our issues of August 6th, 13th and 20th, when we dealt with the construction of the hull and the design and arrangement of the public rooms and cabins, the propelling and auxiliary generating machinery, and finally the very modern refrigerating equipment installed in these vessels by J. and E. Hall, Ltd. It may be recalled that the new Union Castle liners each have a length of 749ft, a beam of 83ft 6in, and a measurement of 28,705 gross tons. Two classes of passengers are carried, 227 first class and 478 cabin class. The propelling machinery is designed with sufficient reserve of power to maintain a service of twelve and a half days from Southampton, which is the ultimate aim of her owners. Parsons twin-screw, triple-expansion, geared turbine machinery was chosen, and steam is raised in three Babcock and Wilcox oil-fired, water-tube boilers, arranged for controlled superheat. The boilers have a designed working pressure of 600 lb per square inch and a final superheated steam temperature of 850 deg. Fah. The designed output for each boiler corresponding to a ship's speed of 21 knots is 80,000 lb of steam per hour. Two Cochran boilers are used for supplying the domestic heating load. For electricity supply there are three 1200-kW Allen geared turbine sets, while two 900-kW oil engine-driven sets of the Harland and Wolff coverless design are used for service when in port. A feature of these liners, as, indeed, of all the new liners of the year, was the improved accommodation for the officers and crew.

In early December the new Orient liner "Orcades," which was designed and built by Vickers Armstrongs, Ltd., at its Barrow-in-Furness Naval Yard, left Tilbury on her maiden voyage to Australia. She is shown on one of our Supplement pages, and is a larger and faster ship than the company's earlier vessels, and will reduce the pre-war voyage time from England to Melbourne, Australia, from thirty-six to twenty-eight days. A new feature is the combined navigating bridge and funnel casing which is surmounted by a tripod mast. The deck lay-out permits of generous spaces for games, most of which are protected by sheltering screens. A description of the "Orcades" was given in our issues of December 17th and 24th.

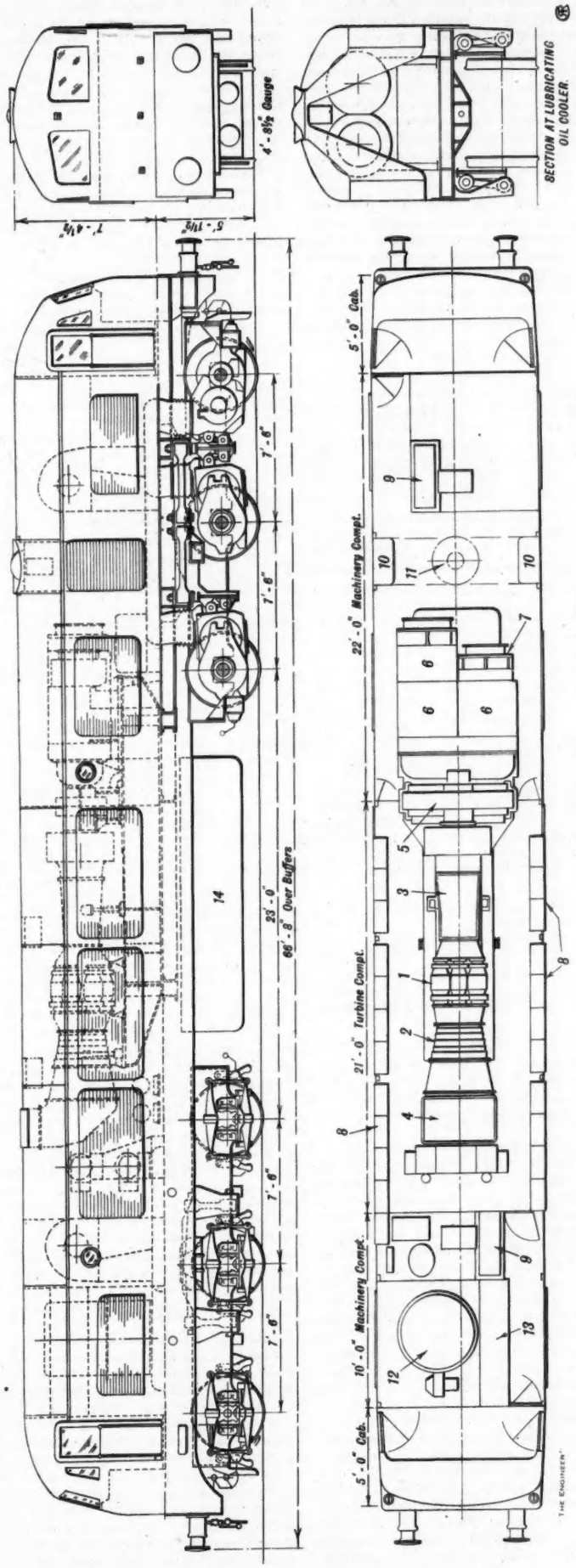
With a length of 708ft 8in, a breadth moulded of 90ft 6in, and a draught of 31ft, the "Orcades" has a designed service speed of 22 knots and a gross registered tonnage of 28,200. She is designed to carry 773 first class and 772 cabin class passengers and 617 officers and crew, making a total ship's complement of 2162 persons. The twin-screw propelling machinery has a normal service power of 34,000 s.h.p., and a maximum overload power of 43,500 s.h.p. Steam is generated at a pressure of 525 lb per square inch and a superheated temperature of 580 deg. to 600 deg. Fah. in Foster Wheeler water-tube, oil-fired boilers, arranged for controlled superheat. There are two large and two smaller boilers. Four Allen 850-kW geared turbine generator sets supply the current for lighting, heating and auxiliary machinery.

We illustrate herewith another interesting ship which entered service during the period under review. She is the "Commandant Quéré," which was designed and built by John Thornycroft and Co., Ltd., at Southampton, for the French Naval Administration, and is now operated by the Compagnie Générale Transatlantique. In June she left the Solent after successful trials for Marseilles, where she has taken up the mail and passenger service between that port and Corsica. A description of the liner will be found in our issue of July 2nd. With a length of 363ft and a breadth of 50ft and a 17ft draught, the liner has a designed speed of 18 knots. About 1000 tons of cargo is carried. Three classes of passengers include tourist, third and fourth class, for which accommodation for over 1000 has been provided. Parsons geared steam turbine machinery of 5400 s.h.p. was chosen, taking steam from two Thornycroft oil-fired, water-tube boilers, each designed for a working pressure of 300 lb per square inch and a final superheated temperature of 700 deg. Fah. The funnel top of this ship has been designed to lift the smoke and products of combustion clear of the after decks.

(*To be continued*)

B.I.O.S. OVERALL REPORT.—The B.I.O.S. Overall Report No. 12, just published by the Board of Trade, price 1s., post free 1s. 1d., is devoted to an analysis of the many different German ideas which went into their gas turbine research and manufacture. The report deals with the design of the various components, such as compressors, turbines and blade-cooling, combustion, fuel systems and heat exchangers; another section is concerned with a review of the various applications of gas turbines, including the interesting Lurgi gas turbine, a 12000kW power generation project, which was intended to utilise gas from high-pressure gasification of brown coal. Owing to their lack of high grade alloys, the Germans were forced to evolve various designs of hollow blades with internal cooling, partly by air and partly by water. On rotary heat-exchangers for gas turbines German developments were ahead of similar work in this country and much of interest can be learned from them. Another interesting piece of research was the use of mixed sintered iron and alumina to produce a material for blades The report contains forty-six pages and several diagrams, as well as forty-six references to other published information on German research and a subject index.

GAS TURBINE LOCOMOTIVE FOR BRITISH RAILWAYS



METROPOLITAN-VICKERS GAS TURBINE LOCOMOTIVE

Gas Turbine Locomotives for British Railways

WE have received from the Western Region of British Railways some interesting notes on the progress which has been made in the construction of the gas turbine electric locomotives being built by Brown-Boveri, Ltd., and the Metropolitan-Vickers Electrical Company, Ltd.

THE METROPOLITAN-VICKERS GAS TURBINE LOCOMOTIVE

In the initial descriptions which accompanied the earlier announcements of the locomotive to be designed and constructed jointly by the Western Region and the Metropolitan-Vickers Electrical Company, it was pointed out that the construction programme was based on a power plant involving a minimum of new design. It was in fact similar to the marine propulsion gas turbines supplied to the Admiralty. These turbines, in turn, were based on the "F2" aircraft jet propulsion units, which had been in production for some time. The application of such a plant to a locomotive would have involved some sacrifice in thermal efficiency if used without waste heat recovery and, therefore, a heat exchanger formed part of the locomotive power equipment.

As the complete locomotive project developed it became evident that, for reasons unconnected with the power plant, the original construction programme could not be realised and that the amended programme offered the possibility of incorporating in the locomotive a new gas turbine, which the company had already projected as a standard power plant for high performance locomotives. With the approval of Mr. F. W. Hawksworth, the chief mechanical engineer of the Western Region, the detail design of the new power plant was put in hand and this unit is now in an advanced stage of construction at the Metropolitan-Vickers workshops in Manchester.

The new plant is claimed to have several important advantages over the scheme which it supersedes, the fundamental one being that the combined thermal efficiency of its turbine and compressor units has been raised to the point of yielding the same overall efficiency without a heat exchanger as the earlier design could offer with an exchanger. The heat exchanger has, therefore, been dispensed with, making a considerable reduction in the weight and bulk of the plant. The increase in thermal efficiency is mainly due to two factors : in the first place, because the plant has been designed expressly for railway traction it will operate under the most favourable conditions ; and, in the second place, advantage has been taken of recent axial flow compressor developments made by the company's designers to utilise a considerably higher compression ratio than that of the superseded plant.

The reduction in weight of the prime mover has permitted the installation of a unit of increased power and transmission equipment of higher continuously rated tractive effort without increasing the locomotive weight, notwithstanding the substitution of cast iron and steel for the aluminium alloy used in the compressor of the original plant. Further, the reduction in the bulk of the plant has improved the lay-out of equipment in the locomotive body and made possible a through passage between the driving cabs, with ready access to the components at all times.

Another important change from the earlier design is the adoption of the single-shaft arrangement, in which one turbine unit only is directly coupled to the compressor unit and drives both that machine and the external load. This arrangement is considered desirable in a power plant for locomotive applications, so that dynamic braking can readily be provided, where conditions require it, through the traction motor and generators and the compressor unit. In this particular locomotive the length and severity of gradients on which it will be used are not sufficient to require this form of braking. The control equipment embodies the special features necessary for the automatic acceleration of a machine, with the

turbine and compressor mechanically coupled when increased output is demanded.

The principal dimensions of the locomotive, a drawing of which we reproduce on page 25, are:

Length over buffers	66ft 8in
Bogie wheelbase	15ft
Bogie centres	37ft 10in
Total wheelbase	53ft
Body width	9ft
Height above rail	12ft 10in
Total weight	120 tons
Adhesive weight	120 tons
Maximum speed	90 m.p.h.
Maximum tractive effort	60,000 lb
Continuous rating tractive effort	29,000 lb

The three main components of the thermal plant are an axial flow compressor, a combustion chamber of the flame-tube type, and an axial-flow turbine, in which air, as the working fluid, is subjected to the cycle of compression, heating and expansion. The output is 35 per cent of the power produced by the turbine, the compressor absorbing the other 65 per cent.

The fifteen-stage compressor comprises a cast iron stator and a forged steel rotor fitted with stainless steel blading. A five-stage turbine is built up from a cast austenitic steel stator and a forged austenitic steel rotor, the blading being of nickel alloy and of austenitic and ferritic steels. Each of these rotors runs in two plain bearings and their adjacent shaft ends are coupled through a semi-flexible steel coupling. The full load rotor speed is 7000 r.p.m.

The combustion chamber mounted between the compressor outlet and turbine inlet is supported from the stators of these machines, and consists of six cylindrical flame-tubes symmetrically disposed around the coupling of the motors and with axes parallel to the machine axis. The flame-tubes are constructed entirely of steel, mainly of the austenitic heat-resisting type, and are provided with quickly detachable joints for ease of maintenance. The chief consideration in choosing the flame-tube design rather than the annular type was that of access to the coupling and inboard bearings.

The compressor, turbine and combustion chamber are carried as a unit on the underbed by fixed and sliding supports, designed to give complete freedom for expansion.

The turbine output is absorbed in three main generators, an auxiliary generator and an exciter, all of which run at 1600 r.p.m. at full load. Power is transmitted from the turbine through a single reduction gearbox with one central 7000 r.p.m. single-helical pinion and two 1600 r.p.m. gearwheels having their axes in a horizontal plane. One of the low-speed shafts drives two main generators and the other drives one main generator and the auxiliary generator and exciter. All five electrical machines are built together as a unit and, with the gearbox, are carried on the underbed that supports the gas turbine. The complete, 27ft long, power unit is carried on three supports on the locomotive underframe and, as will be seen from the drawing, is disposed approximately centrally in the body, with passageway on each side.

Each of the three main generators supplies power to two axle-mounted traction motors, which drive their axles through torsionally resilient single-reduction spur gears. The auxiliary generator provides power for the locomotive auxiliaries, which include a storage battery for starting the turbine by using the main generators as motors for the initial period.

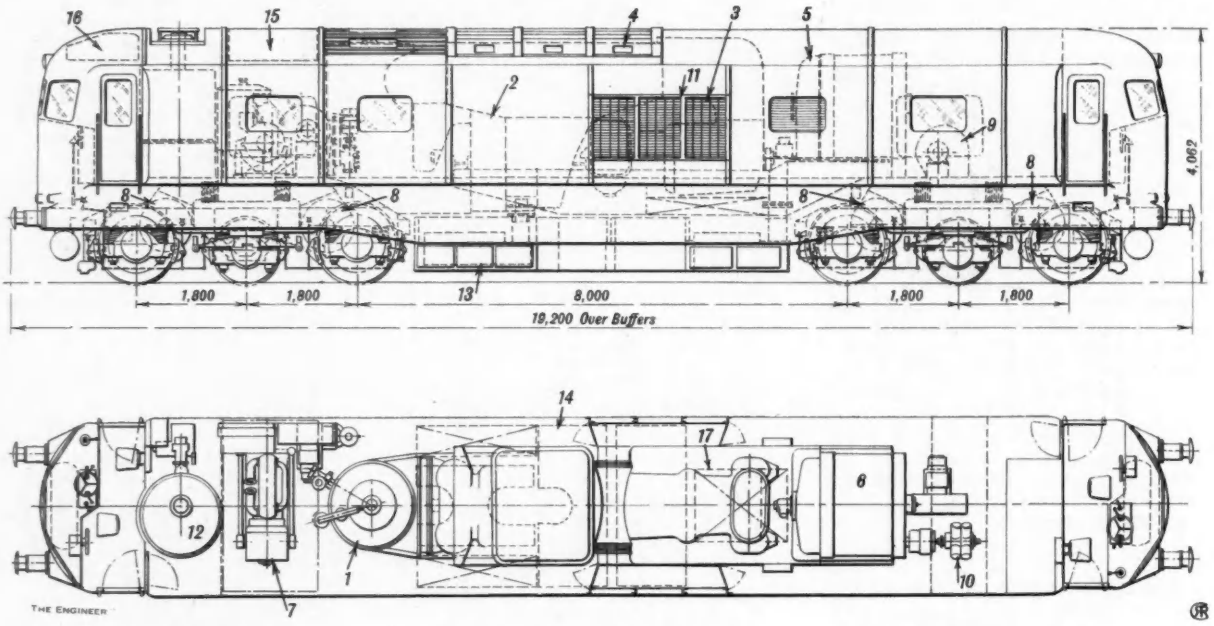
The principal motor-driven auxiliaries are a pump unit for fuel and lubricant, a cooling fan for the lubricant cooling radiator, an air compressor and vacuum exhausters for the locomotive and train brakes, and forced ventilation blowers for the traction motors. A semi-automatic oil-fired boiler supplied steam at 80 lb per square inch for heating a train through its normal heating system. All the air for the gas turbine is filtered through dry fabric filter panels set in the walls of the machine compartment. These filters are designed to clean the air of all impurities except those of very fine particle size, and their use will extend the periods between blade cleaning operations.

The locomotive is of the conventional double-bogie type, with driving cab at each end of the superstructure, so that it can be operated equally well in each direction. Each bogie has three axles all of which are motor driven. The N.T.P. rating of the turbine is 3500 h.p. at 7000 r.p.m. When due allowance is made for summer temperatures, average altitudes, auxiliary demands and transmission losses, the power available at the rails will be approximately 2700 h.p., varying only slightly over the normal speed range. The maximum speed will, it is stated, be 90 m.p.h. and the maximum tractive effort 60,000 lb. Between these limits the control equipment sets the fuel input and regulates the generator and motor field strengths to maintain the turbine output steady at the value selected by the driver on the master controller, irrespective of variations in train speed with changing gradients.

Estimates of train resistance show that a 650-ton passenger train of eighteen coaches will balance at over 80 m.p.h. on level track and at about 40 m.p.h. and 25 m.p.h. up gradients of 1/150 and 1/100 respectively. It would be possible to haul a goods train of 1000 tons up a 1/100 gradient at 25 to 30 m.p.h., but power would have to be reduced to keep within safe speed limits on level track.

The full load thermal efficiency of the turbine is calculated at about 20 per cent, falling to about 16·5 per cent at half load, and the overall efficiency to the rails is about twice that of a modern steam locomotive. Gas-oil fuel will be used for both the turbine and the train-heating boiler.

From the driver's point of view, the control of the power plant is being reduced to extreme simplicity. The controls comprise a reversing lever and a power lever in addition to controls for brakes, sanders and other purposes. The power lever can be set to give the required proportion of full load at which the turbine is to be automatically controlled.



1. Combustion Chamber
2. Gas Turbine
3. Air Compressor
4. Air Preheater
5. Reduction Gear
6. Main Generator
7. Diesel Generator Set for Auxiliaries
8. Traction Motors
9. Fan for Traction Motors
10. Compressor and Vacuum Pump
11. Lubricating Oil Radiators
12. Train Heating Boiler
13. Storage Battery
14. Heavy Fuel Oil Tanks
15. Water Tank for Boiler
16. Light Fuel Oil Tank
17. Lubricating Oil Tank

BROWN-BOVERI GAS TURBINE LOCOMOTIVE

BROWN–BOVERI GAS TURBINE LOCOMOTIVE

Late in 1946 the Great Western Railway Company, on the recommendation of Mr. F. W. Hawksworth, placed an order with British Brown–Boveri, Ltd., for a 2500 h.p., 90 m.p.h., gas turbine electric locomotive.

The locomotive, which is now in course of manufacture, is being designed and constructed at the Brown Boveri works, Baden, Switzerland, and the mechanical portion is being built by the Swiss Locomotive and Machine Works, Winterthur. It will be basically similar to the one built by the same firm in 1941 for the Swiss Federal Railways and which up to the present is the only locomotive of its kind in regular service. The new locomotive will,

however, incorporate several improvements on the original design and will be of rather higher capacity.

The arrangement of the new locomotive can be seen in the drawing we reproduce and its principal details are as follows :—

Continuous net output of the gas turbine unit	2,500 h.p.
Tractive effort at the wheel rim :	
At starting	31,500 lb up to about 21 m.p.h.
Continuously	12,400 lb at about 64 m.p.h.
Maximum continuous speed	90 m.p.h.
Weight in running order	About 115 tons
Weight for braking	About 115 tons
Adhesive weight	About 77 tons
Length overall	63ft
Fuel	Furnace fuel oil sufficient for 250 miles

The gas-turbine unit consists essentially of an axial-flow compressor, a heat exchanger, a combustion chamber and a gas turbine. The compressor is driven by the turbine and the air, which is compressed to about 45 lb per square inch gauge in the compressor, is fed to the combustion chamber through the heat exchanger. In the combustion chamber the fuel oil is consumed with only a portion of the air. The remaining and much greater portion of the air by-passes the actual combustion chamber and mixes with the products of combustion in order to reduce the combustion temperature to a maximum of about 1100 deg. Fah. before the turbine. This mixture of air and products of combustion is expanded through the turbine and useful work is produced. The turbine exhaust gases escape to the atmosphere through the roof of the locomotive after passing through the heat exchanger. In the heat exchanger a portion of the heat in the exhaust gases is transferred to the air being delivered to the combustion chamber to raise its temperature to about 500 deg. Fah.

At full load the turbine develops about 10,300 h.p., of which the compressor absorbs about 7800 h.p. The difference of 2500 h.p. is transmitted to the generator set through a reduction gear, and the electrical energy is transmitted to the driving axles by electric motors.

The locomotive is carried on two six-wheel bogies, each outer axle of each bogie being driven by a d.c. series motor completely suspended to reduce the unsprung weight to a minimum. A driving cab at each end of the locomotive makes it equally suitable for running in either direction without turning. One man control is provided, as well as standard Western Region automatic train control apparatus.

Compared with an efficient express steam locomotive, the fuel consumption of this gas turbine electric locomotive is expected to be less than half for equal work done.

Taxation and Shortage of Industrial Capital

In a memorandum which has been sent to the Chancellor of the Exchequer, the Federation of British Industries has drawn attention to the grave and urgent problem arising from the lack of capital needed by industry to replace or modernise fixed assets and to maintain, or where possible expand, current production.

The memorandum says that the primary and major cause of this shortage of capital is the rise that has taken place in costs, prices in general having risen to more than 200 per cent of the pre-war level. In previous periods of inflation it has been possible to provide increased capital by substantial additions to reserve out of enhanced profits during the period of rising costs, but the present high level of corporate taxation and the particular way in which it operates has ruled out this possibility. In some industries the regulations imposed by Government price controls have prevented adequate provision being made, and in many there is now a shortage of the working capital which is essential to the achievement of maximum production.

The F.B.I. considers that this problem falls into two parts. First, the need to ensure as far as possible that taxation is levied on profits only after proper provision has been made for maintenance and replacement of raw materials, buildings, plant and machinery. In regard to fixed assets in the form of buildings, plant and machinery, the wear and tear allowances based on the original cost clearly do not meet the situation, as under existing taxation provision, for every £1 given in wear and tear allowances, an average of £3 in the earnings from current production is needed in order merely to counteract the change in price levels. Secondly, there is the need so to frame the incidence of tax that industry can provide additional working capital from its own resources. The taxation of profits of corporate bodies over and above the ordinary rates of income tax is not only open to serious objection on grounds of principle, but makes it much more difficult, particularly as it applies to undistributed profits, for industry to find the additional working capital it needs. It must, the Federation believes, be in the national interest that industry should in large measure find this additional working capital from its own resources.

On the first point the F.B.I. says that there may well be a strong *prima facie* case for adopting for purpose of taxation a system of calculating profits which takes into account the difficulties referred to in the preceding paragraph. It cannot, however, be ignored that it would be difficult to devise a scheme introducing a fundamental change in the definition and computation of profits without very thorough and complete examination of the implications of such a step throughout the range of industry. The Federation feels, however, that it would be on all counts desirable that an official enquiry should be set on foot, for example, through the medium of a departmental committee, to examine the practicability or otherwise of adopting a basis for calculating profits, which takes care of marked changes in the value of money upwards or downwards. It is accordingly recommended, as a long-term policy, that the Chancellor of the Exchequer should initiate such an enquiry and the Federation states that it would be glad to give every assistance in its power to any such committee of enquiry that might be set up. It is clear, however, the memorandum continues, that the complexities of the subject are such that any examination of the kind recommended would take a considerable time and certainly could not be completed soon enough to affect the 1949 Budget. At the same time, the F.B.I. suggests, that some action is called for now, if there is not to be a real risk of industrial decline. Obviously in many cases the process of rehabilitation of equipment or working capital must extend over a period of years, and it is therefore submitted that in view of the great urgency, interim measures must be adopted without prejudice to a sound solution of these questions of principle.

The interim measures which are recommended are that to deal with the problems of replacement of fixed assets, for 1949–50 and until notice, a special allowance should be granted, in arriving at profits, in the form of a fixed sum. It might, for example, be based on the whole depreciation allowance granted for 1945 46, suitably adjusted. This allowance would be outside the wear and tear calculations and would not be deducted from the written down value. The year 1945–46 is taken as being the latest year before post-war re-equipment started, and is thought to be the most suitable. Any reference period, however, will produce some inequities, for example, the year 1945–46 would not give the necessary help to "concentrated" industries but the hope is expressed that the door would be open to such special cases being given favourable treatment on their merits. To deal with the problem as it affects working capital, stocks, &c., it is suggested that for 1949-50 and until notice substantial reduction in taxation should be conceded on profits withheld from distribution in those years with the defined object of assisting businesses to finance restocking, &c. Such a concession might, of course, be subject to the condition that, should profits so withheld be withdrawn and distributed—as distinct from being used in the business—the tax relief would have to be surrendered. The two proposals, the memorandum observes, are complementary but they are not necessarily interdependent. Combined, they are a direct and definite encouragement to the sound industrial finance that the present situation requires. It is believed that both proposals are administratively workable but this would have to be confirmed in discussion with the Inland Revenue authorities. Both are capable of adjustment to whatever total figure the Chancellor is disposed to set aside if he is sympathetic to the objects they are designed to secure.

Rolling Stock Standardisation on British Railways

An announcement by the Railway Executive states that considerable progress is now being made with the preparation of preliminary designs for standard locomotives and rolling stock for British Railways. In view of the very large numbers of units involved (19,726 locomotives, 55,379 coaching and 1,178,993 freight vehicles), this policy of standardisation must necessarily be a long-term one. It is anticipated that, in addition to the direct supercession of old units by new ones, considerable use will be made of new standard details in the repair of non-standard vehicles.

Standardisation both of complete units and components had, of course, been in progress in the railway industry for many years prior to nationalisation, a notable example of which was the locomotive standardisation carried out by the former L.M.S. Railway. This company between 1923 and 1945 reduced its locomotive stock from 10,316 to 8049, at the same time reducing the number of different classes from 400 to 133. Considerable progress in rolling stock standardisation had also been made by the other main line railways.

The Railway Executive, therefore, inherited the accumulated results of a large number of separate standardisations, but in spite of this the stock which it has taken over from the former companies was far from standardised as a whole. Except in the case of the major wagon components, there was no inter-standardisation of complete units nor of components as between the former main line companies, except in the relatively small extent to which they followed British Standard Specifications. Because of the long life of the units and because of the uneconomic cost of applying new standard details retrospectively to old stock, each company had within its total stock a number of successive stages of standardisation sometimes differing widely in nature. For the most part former companies were subject to the long-standing custom by which each new chief mechanical engineer initiated fresh standards of his own. A notable exception to this was the G.W.R., which over a period of over forty years followed a single standardisation scheme for its locomotives under successive chief mechanical engineers.

Under the Railway Executive the standardisation of a complete unit is in the initial stages, and proposals are nearing completion for the first two standard steam locomotive classes out of a possible twelve, and for standard type of chassis and mechanical equipment for a single type of diesel shunting locomotive. Preliminary designs are also being worked out for a basic all-steel carriage design suitable for mass production. Work has commenced on standard merchandise and covered goods wagons, and other types will be dealt with in relation to operating needs.

So far as details and materials are concerned, policy committees are at work examining present practices and making recommendations for standards, item by item, both for adoption

in the complete designs and for eventual adoption on existing stock if this can be shown to be economic. A special case is that of wagons, where an R.E. Policy Committee is carrying on the work of the old C.M.E.'s Sub-Committee of the former companies, in continuing the standardisation of wagon details.

One of the difficulties in any scheme of standardisation is to keep it fluid and open to the inclusion of new ideas and improvements as they arise. To meet this objective it is intended to build prototypes of advanced designs, such as the gas turbine locomotives and light alloy passenger and freight stock, and by continuous experiment to try out improved details. At intervals the existing standard design will be re-examined and proved, and tested new features, which offer greater efficiency or availability or reduced cost, will be included in a "Mark II" version of the standard.

So far as the British Standards Institution is concerned, it is proposed to work in the closest co-operation in connection with the future development of standard railway rolling stock. Existing specifications will be used wherever possible, and where they cannot be used or have to be amplified, information accordingly will be passed to the B.S.I. Furthermore, the B.S.I. will be advised of mechanical and material standards which the Railway Executive decides to adopt and for which no specification exists.

The advantages accruing from standardisation in railway rolling stock will arise as increasing numbers of new units are built to standard designs and embodying standard details. A lesser but valuable result will accrue in so far as these standard details can be applied as and when renewals are required to existing stock with little or no structural alteration. There will remain, however, a residue of features and details on the new standard rolling stock where the expenditure involved in applying them to existing vehicles could not be justified.

The New Year Honours

THE list of New Year Honours to be conferred by the King, which was published on Saturday, January 1st, contains the names of several engineers and scientists and of others prominently associated with the engineering and allied industries. Among the Knights Bachelor is Dr. Henry Lewis Guy, F.R.S., who is well known to many of our readers as the Secretary of the Institution of Mechanical Engineers. Prior to taking up that office in October, 1941, Dr. Guy was for many years chief engineer of the Metropolitan-Vickers Electrical Company, Ltd., and was responsible for a number of inventions and researches directed towards the improvement of steam power plant. During the war, Dr. Guy served on the Ministry of Supply's Advisory Council on Scientific Research and Development, and on many other important committees, and since 1944 he has been a member of the Advisory Council to the committee of the Privy Council for Scientific and Industrial Research, and a member of its Industrial Grants Committee. In 1945, Dr. Guy became Chairman of the Department of Scientific and Industrial Research Committee on "The Essential Requirements for Research in Mechanical Engineering," which was set up by the Lord President of the Council. He is also Chairman of the Mechanical Engineering Research Board of the D.S.I.R. Knighthoods are also conferred upon Mr. Joseph Holland Goddard, President of the Machine Tool Trades Association, and chairman of Wadkin, Ltd., and National Steel Foundry (1914), Ltd.—an honour which comes appropriately at the end of the year in which the first post-war and very fine Machine Tool Exhibition was held—Mr. Archibald J. Gill, Assistant Director-General (Engineering), G.P.O.; Mr. John Hacking, M.I.E.E., Deputy Chairman of the British Electricity Authority; Mr. Donald MacLean Skiffington, director of John Brown and Co., Ltd.; Mr. Thomas E. B. Young, M.I.C.E., production member of the National Coal Board; Mr. Claude Plowman, for services to engineering in the State of Tasmania; and Mr. William Lawther, President of the National Union of Mineworkers.

In the Civil Division of the Order of the Bath, Sir Henry Tizard, F.R.S., Chairman of the Defence Research Policy Committee, becomes G.C.B., and Colonel P. G. J. Gueterbock, chairman of the British Non-Ferrous Metal Smelters' Association, becomes a K.C.B. In the Military Division, the honour of C.B. is conferred upon Major-General A. D. Campbell, late Corps of Royal Engineers. In the Military Division of the Order of the British Empire, Engineer Rear-Admiral S. O. Frew and Lieut.-General F. G. Wrisberg become K.B.E., and the C.B.E. is awarded to Captain (E.) O. W. Phillips, R.N. (Ret.), Engineer Rear-Admiral H. S. Roome, Instructor Captain J. C. N. Taylor, M.Eng., and Colonel H. L. Lendrum. In the Civil Division, the C.B.E. is conferred upon Mr. Atholl Blair, M.I. Mech. E., M.I.N.A., engineer manager and director of Harland and Wolff, Ltd.; Alderman Walter Bradley, A.M.I.Mech.E., Chairman of the National Joint Industrial Council for the Road Passenger Industry; Mr. O. V. S. Bulleid, M.I. Mech. E., Chief Mechanical Engineer, Southern Region of British Railways; Mr. J. R. Caseley, M.I.C.E., deputy director of Opencast Coal Production, Ministry of Fuel and Power; Mr. P. A. Cooke, Director of Engine Production, Ministry of Supply; Colonel W. C. Devereux, F.R.Ae.S., chairman of International Alloys, Ltd.; Mr. I. G. Evans, assistant secretary, D.S.I.R.; Lieut.-Colonel F. G. Hill, M.I.C.E., deputy chief engineer, Ministry of Health; Mr. J. A. Milne, chairman and managing director of J. Samuel White and Co., Ltd.; Mr. James Mitchell, managing director, iron and steel production, Stewarts and Lloyds, Ltd.; Professor F. H. Newman, D.Sc., A.M.I.E.E.; Alderman Charles Terry, chairman of Herbert Terry and Sons, Ltd.; Mr. Harold Wilmot, President, Locomotive Manufacturers' Association of Great Britain; Lieut.-Colonel E. H. E. Woodward, M.I.E.E., member of the British Electricity Authority; and Mr. R. T. B. Wynn, M.I.E.E., assistant chief engineer, British Broadcasting Corporation.

Canadian Engineering News

A Concrete Mixing Plant

The Ontario Hydro-Electric Power Commission's post-war programme of water-power development has called for the placing of hundreds of thousands of cubic yards of concrete. An improved central concrete mixing plant decided upon provides for fast, accurate, automatic weigh batching; automatic compensation for variations in sand and fine gravel mixture content; instantaneous mix changes with a mix selector; interlocking operations to prevent errors; centring of all controls on one control board, and complete, detailed records of every batch poured. The plant is carried on four steel columns and is housed in timber sheeting as a protection against the weather. The upper part of the plant spreads out into an octagonal steel-plated shell which provides storage compartments for the materials for each run or batch. The aggregate bins are arranged radially around the central shaft, where the cement is stored. In the case of aggregate, the bins are charged from the stockpiles by an inclined conveyor belt. A bucket elevator takes care of the cement.

When the mechanism has been set for the type and quality of concrete required for a particular job, the operator at the control board turns a switch and the aggregates, water and cement, begin to flow freely down into another set of smaller bins, where they are automatically weighed. When the exact proportions required are assembled, the flow from the storage bins is automatically closed off and the materials descend and come together in a circular collector cone, where they pass through a motor-driven swivel chute into one or other of three mixing machines. After mixing, the concrete is poured into the hoppers and the cycle is begun again.

For distributing the concrete to the main dam and part of the powerhouse at the Hydro Commission's Stewartville project on the Upper Ottawa River, two 30in conveyor belts have been used. These belts carried the concrete from the batching and mixing plant over the line of the dam on a specially designed steel trestle consisting of 80ft span trusses, supported on braced steel towers. The conveyors were carried on the top and bottom chords of the trusses and were automatically tripped to discharge the concrete through chutes and "elephant trunks" into the forms.

A Tidal Power Scheme

Canada and the United States have ordered a new survey of the Passamaquoddy project for harnessing the Bay of Fundy tides for electric power. The scheme has been dormant since 1936, after a 7,000,000 dollar investment by the United States. It has now been referred to the International Joint Commission for a limited review. The plan, proposed originally in the early 1920s, is for the production of 3,000,000kWh of electricity annually. It would involve the damming of Passamaquoddy Bay, on the border, and Cobscook Bay, lying wholly within the State of Maine. Power would be produced by controlling the flow between the two basins. Opposition to the original plan developed in New Brunswick and Nova Scotia, chiefly because of possibility of damage to the herring-sardine industry. The charter of the Canadian company formed to do the work lapsed in 1929, before the company had been able to make a start. It was not until 1935 that the United States Government allotted 10,000,000 dollars in W.P.A. funds to start a project on Cobscook Bay and about 7,000,000 dollars was spent, largely in building a model community on the bay shore. The undertaking was then abandoned.

A Plastic Board Plant

A new use for the great amounts available of waste sawdust, wood shavings, and trimmings, edgings, slabs and bark, is foreshadowed by the announcement that contracts have been signed for the construction of a "Plasswood" factory at South Nelson, New Brunswick. This will be the first plant of its kind in Canada. The "Plasswood" process converts all kinds of wood waste into a wide range of wood products through the use of special drying equipment and the admixture of a urea synthetic resin. Flat or curved boards are produced by the use of multiple opening hydraulic presses. Intricate sections can also automatically be produced by extrusion. The South Nelson plant is expected to be in operation within six months to produce 25,000 board feet a day.

Cellophane Plant Extensions

Plans for a 4,000,000-dollar addition to the cellophane plant at Shawinigan Falls, Quebec, have been announced by Canadian Industries, Ltd. When completed, the enlarged plant will increase production by 200 per cent over pre-war output. Work on the new project will begin immediately and is expected to be completed in 1951.

Power Extension Project

Great Lakes Power Company, Ltd., has approved plans for an extension of power at High Falls on the Michipicoten River. The company is installing an additional 13,000 h.p. unit. The head at this plant is approximately 149ft. Extra water storage will be created by rebuilding the existing dam at Manitowic Lake, and raising the elevation of the impounded water.

Aluminium Plant Surveys

The Aluminum Company of Canada announces that it is beginning an engineering study of potential power sites in British Columbia, increasing "the probabilities of a new aluminium industry on the west coast, similar to that established at Arvida, in the province of Quebec." Following selection of the most promising site, the next step would be a complete engineering study to determine the costs of developing a hydro-electric plant and an aluminium plant, town site, docks and other facilities.

Electronic Tube for Acceleration Measurement

THE accurate measurement and recording of acceleration by electronic methods is made possible by the "DDR 100" accelerometer tube recently introduced by Mullard Electronic Products, Ltd., Century House, Shaftesbury Avenue, London, W.C.2.

This device isbasically sim lar in construction to an all-glass valve of the loctal type, and has the advantage that it may be mounted in any attitude. This characteristic, coupled with the high output and excellent response of the tube at low and zero frequencies, enables it to be used with great advantage as a low mass pick-up for measuring and recording the acceleration and vibration of high-velocity elements. One of the chief advantages resulting from the high output of the tube is that it makes possible the observation and recording of acceleration without the necessity of using a special high-gain amplifier. This is a desirable quality in certain flight tests in aircraft, and among the numerous applications of the tube to a ronautical research is the measurement and recording of vibration on aircraft in flight. The tube should also prove of value in many fields of industrial research where the advantages of small size, light weight and high output are required. It may also be used quite successfully for displacement velocity measurement and recording.

The "DDR 100" accelerometer is a double diode with anodes elastically supported so that the anode impedance is varied when the tube is subjected to acceleration. In practice, the tube is rigidly clamped to the structure under test and the measurement is expressed in terms of a current change in a Wheatstone bridge circuit, of which the anode/cathode impedance of the accelerometer tube forms adjacent arms.

Response to sinusoidal acceleration can be considered independent of frequency over a range of 0 to 250 cycles per second. The resonant frequency of the tube is 1 kilocycle per second, and the maximum acceleration range is 100g, where g is the gravitational constant. The tube is designed for a heater voltage of 6·3V and a maximum anode voltage of 10V. The maximum dimensions of the tube are given as: overall height, 78mm; seated height, 63mm; overall diameter, 30mm.

The output of the tube is sufficient for recording directly on a low impedance galvanometer or micrometer, but where necessary the bridge output may be fed into an amplifier and cathode ray oscilloscope, in which case the sensitivity will be $7 \cdot 5\text{mV}/g$.

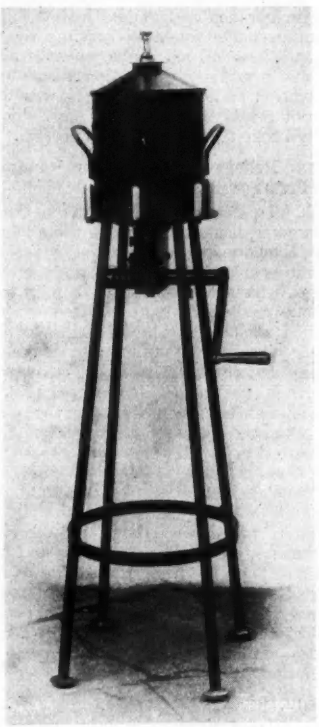
A Concrete "Workability" Meter

IN the course of his Presidential Address before the Society of Engineers in 1947, Mr. V. S. Wigmore spoke of preliminary work upon which he had been engaged in connection with the development of a machine which recorded on a counter the energy required to "work" concrete. The development of this machine has been completed and now, known as the "Consistometer," it is being manufactured by A. Macklow-Smith, Ltd., 8, Malbrook Road, London, S.W.15. Its operation combines penetration and vibration, and it is strongly built to provide a sim le and reliable means of testing concrete on working sites.

When testing concrete in the machine a counter records a number which is known as the consistency factor, which is definitely related to the workability of eth concrete. The more workable a concrete the lower is the consistency factor registered on the machine. Factors ranging from 20 to over 800 are registered on the counter of the machine, and throughout this range it is claimed that the consistency of a concrete can be accurately determined. The machine can also be used to good effect when designing concrete mixes. In such cases it can be used to show the variation in workability obtained by changing the ratio of sand to coarse aggregate and/or water/cement ratios.

The "Consistometer," a photograph of which we reproduce, consists of a rigid stand about 3ft high, supporting a vibrating platform operated by a handle. Coupled to the drive of the vibrating mechanism under the platform is the counter on which is recorded the consistency factor. A portable container fits on the platform and a steel rod with a bronze ball attached is arranged to pass through the centre of the container cover. This rod can move vertically in the container and is centralised by a guide cap and sleeve situated in the cover.

Prior to making a test the container is removed from the machine and filled with



"CONSISTOMETER" FOR CONCRETE

concrete. Then, after the container has been placed on the platform and the handle turned twice to compact the contents, lightly it is topped up and the cover is placed in position. The counter is set to zero and the ball and rod are inserted in the cover of the container so that the ball rests on the top of the concrete. The handle is then turned and the vibration its mechanism imparts to the platform causes the ball and its rod to sink into the concrete. Turning is continued until a gauge mark about ¼in below the top of the rod is level with the top of the guide sleeve in the container cover. At this point the figure indicated on the counter is the consistency factor of the concrete in the container.

A High-Temperature Insulating Material

PARTICULARS have been received of a high-temperature insulating material, known as "Gyp-Lagging," which is made by Gyproc Products, Ltd., Westfield, Upper Singlewell Road, Gravesend, Kent. This material is of a mineral nature, being composed of exfoliated vermiculite, and is claimed by the makers to possess good adhesive properties and plasticity, together with a high resistance to heat transmission.

"Gyp-Lagging" is supplied in a dry granular form, and when kneaded with approximately three times its weight in water forms a plastic mass, which can be easily applied. On drying, the mass hardens to give a fibrous material of open texture providing a high thermal resistance. The material can be easily applied over irregular shaped surfaces, flanges, valves, &c., and can be safely employed for temperatures up to 1800 deg. Fah., as it is entirely fire-resistant and will not fuse unless temperatures exceed 2000 deg. Fah.

Like other plastic lagging material applied on the working site, the efficiency of "Gyp-Lagging" depends to some extent on securing the right consistency for application. When the work is carried out correctly a flat area of approximately 180 square yards, 1in thick, can be covered per ton of material. The weight of this lagging, when moul ed in place and dry, averages 17 lb per cubic foot.

Good adhesion to metal is ensured by the incorporation of a special binder. This binder contains no caustic, acid or corrosive substances which can harm either the metal covered or the hands of the operatives. The makers point out that, although the material is easily applied, it is necessary to observe certain fundamental rules in application, the most important of which are: the surfaces to be treated must be free from scale, rust, dirt and grease; and the insulant should be mixed with approximately 16 gallons of clean water for every ½ cwt of dry material and homogeneously kneaded to a working consistency. Excessive kneading should be avoided as this increases the density of the material and reduces its heat resistance.

Surfaces to be insulated are first covered with a hand-applied layer, approximately ½in to 1in thick, which must be left rough or "finger-marked" to form a good key for the next layer. When this is dry, thicker layers are similarly applied until the required thickness is obtained, leaving each layer finger-marked for adhesion and allowing it to dry before the next is applied. The final coating, except in cases where a further coating of hard-setting composition is to be added, should be left smooth, care being taken to avoid excessive pressure as this tends to increase the density of the covering. Heat is necessary after the insulation has been applied to promote drying. It is pointed out that most surfaces can be covered without preheating, but if a finish of hard-setting composition is necessary, it is advisable to apply it when the plant is heated, so that it can be easily worked to a smooth, hard surface. Under most operating conditions reasonable strength to resist mechanical wear and tear is secured by finishing in the normal way.

An Institute for Foremen

A NEW educational body for foremen and supervisors, on similar lines to existing professional institutions, has been formed in this country. The new body, known as the Institute of Industrial Supervisors, with headquarters at 47, Temple Row, Birmingham, 2, has five principal objects:—To provide educational facilities for its members in technical and supervisory subjects; to establish the professional status of foremanship and other high grades of industrial supervision; to prescribe the standards of knowledge, training, experience and skill of persons aspiring to this status; to encourage the development and sponsor training of foremen and supervisors; and to improve the efficiency of industrial supervision.

Candidates for admission to the grade of member of the Institute must be not less than thirty years of age, be able to give proof of technical and executive knowledge and have held for at least five years a supervisory position of substance or be able to satisfy the Council of the Institute that they are eligible and desirable for membership. The Institute also has associate and graduate members, associates, affiliates and honorary members.

In September last, Sir Percy H. Mills, the managing director of W. and T. Avery, Ltd., accepted the invitation of the Council to be the first President of the Institute. The General Secretary of the new body is Mr. G. J. Mansell.

Industrial and Labour Notes

Iron and Steel Nationalisation

Members of the Engineering Industries Association have received this week a letter from their President, Lord Davidson, explaining why the Association has publicly stated its opposition to the Iron and Steel Bill. The letter says that the Association's council opposed the Bill to nationalise 107 of the 2000 firms, comprising the iron and steel industry, because it believes the policy to be harmful to every engineering firm.

The effect of the Bill, Lord Davidson points out, would be to disrupt the steel industry, splitting it into three sections—nationalised, licensed and "free"; to substitute a rigid central executive control for the present system whereby there is Government control of broad lines of policy and of prices, but under which individual firms preserve their independence and vie with one another in achieving the utmost efficiency and in studying the needs of their consumers; and to bring Government-owned units in the engineering industries into direct competition with privately owned undertakings, thereby prejudicing the fair allocation of raw materials and of licences.

For these and many other reasons, Lord Davidson's letter ends, the council of the E.I.A. is unanimously opposed to the nationalisation of iron and steel, and hopes that members will do all in their power to "educate those who will be affected by the economic consequences of the Bill at present before Parliament."

London's Unofficial Bus Strike

London Transport's passenger road services were virtually at a standstill on Saturday afternoon and evening last as a result of an unofficial strike. Operating and maintenance workers took this action, against the advice of the Transport and General Workers' Union, to enforce their demand for time-and-a-half payment for work on Saturdays after 1 p.m.

The London Transport Executive, in a statement on the matter, has explained that traffic and maintenance staffs are well aware of their obligation to work on Saturdays and Sundays, an obligation which is taken into account when weekly rates of pay and general conditions of service are agreed with the trade unions. It is the established practice in transport to pay extra rates for work at nights and on Sundays and public holidays, but, the Executive has pointed out, the principle of extra payment—which is really a demand for increased wages—cannot be accepted as applying to Saturday work. In June, 1947, following a claim from the Transport and General Workers' Union, an agreement was made which gave the workers represented a shorter working week, six days' additional holiday with pay, and other substantial improvements in conditions of service. In March, 1948, after another claim by the union, a further agreement was made by which the basic rates of pay for drivers and conductors were increased by 7s. 6d. a week and the rate of extra payment for work on Sunday and Good Friday was increased from time-and-a-quarter to time-and-a-half. Included in this claim there was an application for payment to the road operating staff at the rate of time-and-a-half for work on Saturday afternoon, an application which, however, was withdrawn by the union. The average earnings of a central bus driver are stated to be £7 1s. 6d. a week and of a conductor £6 16s. 6d.

The London Transport Executive informed the Transport and General Workers' Union of its inability to accept the principle of extra payment for Saturday afternoon and evening, which form part of the normal forty-four-hour week. It was added that, should the union feel unable to withdraw the claim, the Executive was agreeable to the matter being referred immediately to the Arbitration Tribunal or to any other competent independent body.

The Transport and General Workers' Union has stated that it will abide by the agreements into which it has entered on behalf of the workers, particularly by the agreement that matters in dispute should be referred to arbitration. Nevertheless, a large number of bus and tramway men expressed their intention to cease work on Saturday afternoons until the Executive granted their demand. On Tuesday of this week it was announced that the Minister of Labour had intervened in the dispute, and was having discussions on the matter with union officials. It was also stated that a notice, signed by Lord Latham, chairman of the London Transport Executive, had been posted in garages and depots intimating that any employee who failed to carry out the terms and conditions of his employment with the Executive would by this action terminate his employment. The Executive, it was added, could not retain in its employ staff who deliberately broke their contracts of service.

Tax Relief for Temporary Commercial Premises

The Council of the London Chamber of Commerce has submitted to the Chancellor of the Exchequer the terms of a resolution concerning tax relief for temporary commercial premises, which was adopted at a recent meeting. The resolution expresses concern at the continued exclusion from tax relief in respect of depreciation of temporary commercial premises erected in areas which have suffered extensive war damage. It is urged that legislation should be introduced for the purpose of removing the hardship at present being borne by the owners of such premises.

The Chamber has pointed out that, under the provisions of the Income Tax Acts, depreciation allowances for income tax purposes cannot be applied to certain types of commercial premises, including warehouses and offices. Owners of such properties who, through war damage, have been compelled to erect temporary premises are consequently doubly penalised owing to the necessarily limited life of those premises and the consequent heavy cost of depreciation.

Lead Prices

The Minister of Supply has made the Control of Non-Ferrous Metals (No. 34) (Copper, Lead and Zinc) Order, 1948, by which the maximum prices of lead were increased £11 per ton on January 1, 1949. The new maximum prices are: good, soft pig lead, £123 per ton, and lead of the quality known as "English," £124 10s. per ton. These changes, it is stated, follow increases in market prices, which affect the cost of imported lead.

Any inquiries concerning the new prices should be addressed to the Director of Non-Ferrous Metals, 20, Albert Street, Rugby.

The Royal Ordnance Factories

In a New Year message to workers in the Royal Ordnance Factories, the Minister of Supply, Mr. G. R. Strauss, has expressed the opinion that the post-war retention of the twenty-one factories still operated by the Ministry of Supply has been justified. Since the end of the war, the message states, those factories have handled £40,000,000 worth of civil and other non-ordnance work.

The Minister says that the nucleus of the wartime ordnance factories has been maintained, has contributed to economic reconstruction, and has proved flexible enough to assume an extraordinary amount of jobs alternative to war work. Non-armament projects which have been undertaken include the production of Services clothing, the packing, identification, and preservation of large quantities of Service stores, and the disposal of Service surpluses, which task alone has provided £12,500,000 worth of metal for civil production purposes.

The Minister's message adds that the Royal Ordnance Factories have often undertaken mass-production of goods requiring a technique totally unfamiliar to them. Thus post-war work has included the manufacture of hundreds of thousands of pre-stressed concrete railway sleepers, production of ceramics for the electrical, cotton spinning and other industries, building of concrete houses, assembling of 16-ton railway wagons in a gun-boring plant at Woolwich, and the execution of numerous light, medium, and heavy engineering jobs.

Trade Disputes

The latest issue of the *Ministry of Labour Gazette* records that the number of stoppages of work through industrial disputes, reported as beginning in November, was 126. In addition, nine stoppages which started prior to November were still in progress in the early part of that month. It is estimated that, during November, 29,200 workers were concerned, directly and indirectly, in these 135 stoppages, and that 88,000 working days were lost. In the preceding month, there were 160 stoppages of work, involving 18,800 people and causing a loss of 54,000 working days.

Taking the first eleven months—January to November—of 1948, there were 1658 stoppages of work through disputes reported to the Ministry of Labour. They affected 411,400 workers and brought about an aggregate loss of 1,912,000 working days. The majority of these stoppages occurred in the coal-mining industry, in which 456,000 working days were lost by 183,500 people in the eleven months reviewed. In the engineering industry, there were eighty-three stoppages involving 48,100 workers and causing a loss of 131,000 working days, and in the shipbuilding industry seventy-five stoppages occurred in which 19,700 workers were involved and 234,000 working days lost. In the comparable eleven months of 1947 there were 1598 stoppages of work reported, through which 604,500 people lost, in the aggregate, 2,353,000 working days.

Index of Industrial Production

A statement issued by the Economic Information Unit early in the week shows that industrial production in October was higher than in any of the preceding months of 1948. The index number of industrial production (1946=100) is estimated provisionally at 127 compared with 124 for September, 1948. Figures for the corresponding months of 1947 were 120 for October and 115 for September. The figures are adjusted for the number of days, excluding Sundays, in each month, but no allowance is made for annual or public holidays.

Changes in Wage Rates

Changes in rates of wages which were reported to the Ministry of Labour as taking effect in November, 1948, resulted in a net increase of about £115,000 in the weekly wages of 488,000 workers. Among the industry groups affected by increased rates of wages were those employed in road vehicle repairing, in Admiralty industrial establishments, the home-grown timber trade and wood box, packing case and wood container manufacture in England and Wales, and women workers in Government industrial establishments. Of the total increase of £115,000, the Ministry says that about £96,000 resulted from arrangements made by joint industrial councils, or other joint standing bodies; about £10,000 was the result of direct negotiations between employers and workpeople or their representatives; and most of the remainder resulted from arbitration awards.

Summarising the changes in wage rates reported in the eleven-month period, January to November, 1948, the Ministry of Labour states that 7,585,500 received increases of wages aggregating £1,849,300. The index figure of rates of wages, on the basis of June 30, 1947=100, rose during those eleven months from 104 to 107 for all workers, the figures for men increasing from 104 to 107; for women from 104 to 109; and for juveniles from 106 to 110.

French Engineering News

(From our French Correspondent)

Latest estimate of the cost to the country of the strikes is 3 million tons of coal, a 15 per cent increase in salary and a 15 per cent pension increase. It is thought that the full extent of damage to pits and installations will only be known in future years.

* * *

The necessity to reform the structure of the nationalised mines is the subject of a series of important observations made by a mining engineer who first stigmatises the instability of the direction, which has already had five presidents and three general directors. Despite the various commissions of inquiry set up from time to time, the engineer says, nothing practical has resulted, and the state of the nationalised mines continues to deteriorate. There is a definite lack of logic and liaison, and the administrative councils include no qualified member to put the point of view of the areas. The writer suggests that only one administrative council on a national scale is needed, knowing the conditions and needs of each mining area. At the moment, the administrative councils of Charbonnages de France have such a limited autonomy and field of action as to be almost powerless.

The mining engineers, he says, are hardly better off. They are bound by red tape, statistics, questionnaires, &c., which paralyse action. Engineers, he claims, need particular patience to be able to reserve some time for technical problems. Their authority is completely sapped and productive work slowed down.

The mines are torn between two opposed tendencies, both anti-industrial. The personnel demand "the mine for the miners," while the other tendency is towards administration. To reduce disorder and effect economies the State tries to introduce rigid rules and multiple controls in the mines, but this is no more compatible with the industry than the miners' anarchy. The engineer concludes by stating that the nationalisation has been a failure on main points, and it is now urgent to reconsider the problem and reconstruct the industry on acceptable lines.

* * *

The Government is proposing that a law be passed to grant a credit amounting to 8 milliard francs to the nationalised coal mines to cover deficits resulting from strikes. Total expenses in October amounted to 5750 million francs, and owing to the strikes, receipts were only 1300 million. In November, the deficit was 3060 million. In the Loire and Gevennes basins, sabotage cost the mines 300 and 200 million francs respectively. Net losses amount to 9 milliard francs. The non-nationalised mining syndicate has asked for an advance of 200 million francs.

* * *

November steel production was the highest since the Liberation, amounting to 672,000 tons, or 29 per cent higher than the 1938 monthly average. Iron production was 656,000 tons, against the 1938 average of 501,000 tons. Steel production per man, calculated on the year, is also 40 per cent higher than in 1938 and 10 per cent higher than in 1929, being 63 tons against 49·3 tons in 1947, 44·8 tons in 1938, and 58·1 tons in 1929. These results are noteworthy as having been attained in a period of reconstruction.

* * *

Extensive modernisation of rolling stock and railway lines is taking place in the Cameroons to remedy deficiencies in communications and means of transport; 30kg rails are replacing light rails in the north, and important orders of rolling stock have been placed. The extension of the Yaounde line towards Nanga-Eboko is now being considered. To overcome the lack of power a hydro-electric plant is being constructed which will, in the first stage, comprise three 10,000-kW turbines. Plant capacity will ultimately be increased to 80,000kW. In addition to supplying power for industrial purposes, the electrification of the railways is envisaged.

Notes and Memoranda

Rail and Road

NEW ANTI-DAZZLE REGULATION.—Owners and drivers of all motor vehicles are reminded by the Ministry of Transport that the new regulation under which it is illegal to use pass lamps so fixed that their centres are less than 2ft from the ground, came into force on January 1st. Fog lamps fixed lower than 2ft may be used only in actual conditions of fog or falling snow. The new regulation does not apply to headlights, which are dipped or extinguished when the dip-switch is pressed.

NEW YORK AUTOMOBILE EXHIBITION.—A representative display of the latest British cars is to be shown in New York from February 5th to 10th, at an exhibition of British and European cars in the Armoury, Lexington Avenue. There will be forty-three stands and British cars are expected to occupy most of them. Sir William Welsh, the Society of Motor Manufacturers and Traders' representative in the U.S.A., is heading a committee representing British and European car interests, to negotiate details with the organisers. Subject to acceptable arrangements, the Society approves participation in the show and it is hoped that all British manufacturers with an interest in the U.S. market will take space, which, it is stated, will be the first collective exhibition of British cars ever held in the U.S.A.

NEW SOUTH WALES RAILWAYS.—The annual report of the New South Wales Railways, covering the year ended June 30, 1948, has just been published. It records that throughout the year operating demands on steam locomotives were heavy, despite restrictions which had to be made through the inability to obtain enough coal. The aggregate mileage run by steam locomotives was 33,921,366 miles and the average load hauled per engine was 297 tons, an increase of 1·02 per cent over the preceding year. The total stock of steam locomotives on the New South Wales Railways increased during the year from 1151 to 1159. The report comments on the conversion of twenty locomotives to oil-burning, and adds that "the task of training enginemen in the technique of oil-firing has been a problem of some magnitude."

Air and Water

RIVER WALL FOR THAMES SOUTH BANK.—The London County Council has accepted a tender for the construction of a river wall on the south bank of the Thames, from County Hall to Waterloo Bridge. The new wall is part of the south bank scheme and is expected to be completed in time for the "Festival of Britain" in 1951. The cost of the work will be nearly £250,000.

AIRCRAFT SAFETY STANDARDS.—Safety standards for the operation of aircraft on scheduled international services have been adopted by the council of the International Civil Aviation Organisation. These are the sixth set of standards to be introduced for international civil aviation. The first five sets were adopted by the council in April last, and included personnel, licensing, aeronautical maps and charts, rules of the air, dimensional practices in air-ground communications, and meteorological codes. They will come into effect on various dates during 1949.

I.N.A. SCHOLARSHIP.—The Institution of Naval Architects is offering a Martell Scholarship in Naval Architecture, tenable for a period of three or four years at Glasgow University. Durham University (King's College, Newcastle-upon-Tyne), Liverpool University, or the Royal Naval College, Greenwich. The scholarship, which is valued at £175 annually, is open to British apprentices or pupils in the Royal Dockyards or private shipyards, the age limit being twenty-three. Entries close on January 15, 1949, and particulars of the regulations and application forms can be obtained from the Institution of Naval Architects, 10, Upper Belgrave Street, London, S.W.1.

Miscellanea

I.E.E. CHRISTMAS LECTURES.—Two Christmas lectures for older school children were given last week at the Institution of Electrical Engineers by Dr. P. Dunsheath. His subject was "Electricity: A Giant Harnessed."

INTERNATIONAL FAIR OF GHENT.—It is intended to incorporate a special British Pavilion in the next International Fair of Ghent, which will be held from September 10 to 25, 1949. Particulars as to space, &c., may be obtained from British Pavilion, Ghent Fair, 395A, Edgware Road, London, W.2.

ROYAL SOCIETY ELECTIONS.—The Royal Society has announced the election of the following Vice-Presidents: Sir Thomas Merton, Sir Edward Salisbury, Sir James Chadwick, and Professor A. C. Hardy.

MECHANISATION IN LEATHER MANUFACTURE.—The London and Home Counties Group of the Society of Leather Trades' Chemists is to hold a meeting at Leathersellers' Technical College, 176, Tower Bridge Road, London, S.E.1, on Friday, January 21st, at 2.15 p.m., for a discussion on "Plant Lay-out, Machines and Mechanisation in Leather Manufacture."

"MECHANICAL MUSIC."—A special exhibition, illustrating the development of "mechanical music" during the nineteenth century, is on view at the Science Museum, South Kensington, until January 22nd. It includes examples of barrel-organs, musical boxes, organettes, and "singing birds," which, it is believed, were first made in Switzerland and France about the middle of the eighteenth century.

THE LATE MR. A. E. SMITH.—We record, with regret, the death, on December 17th, of Mr. Albert Edward Smith, of the Industrial Department of Philips Electrical, Ltd. Mr. Smith, who joined the Philips organisation in 1935, was an authority on industrial rectifiers and specialised in condensers for power factor correction. He represented the company on the B.E.A.M.A. arc welding and capacitor technical committees.

COLUMBIA UNIVERSITY APPOINTMENT.—Dr. Theodore von Karman, director of the Guggenheim Aeronautics Laboratory at the California Institute of Technology, has been appointed an Honorary Professor of Mechanical Engineering at Columbia University. The appointment, it is stated, is in recognition of Dr. von Karman's achievements in the field of aerodynamics. He is well known for his theories of vortex motion and turbulence in fluids, and for his work in supersonic aerodynamics.

ANTWERP OIL REFINERY.—An agreement has been made between the Anglo-Iranian Oil Company, Ltd., and Cie. Financiere Belge des Petroles, S.A., for the construction and operation of an oil refinery on a site leased from the Port of Antwerp. The intake capacity of the refinery will be, initially, 30,000 barrels of crude oil a day. A petroleum dock and turning basin are to be built by the Port to accommodate refinery traffic including large tankers. Construction work will be started this year and it is anticipated that the refinery will be in operation in 1951–52.

RESEARCH IN INDUSTRY.—The Department of Scientific and Industrial Research has published a booklet entitled "Research in Industry," which contains nineteen articles dealing with research progress in a variety of industries. The articles were printed originally in the *Board of Trade Journal*. Among the industries covered are iron and steel, glass, plastics, machine tools, electronics, and light engineering, and as well as showing what has been accomplished already, each article emphasises the value of research in the immediate and more distant future. The booklet is being sold at 1s. 6d. by H.M. Stationery Office.

ARC WELDING INSTRUCTION BOOK.—An instruction book has been published by the Quasi Arc Company, Ltd., Bilston, Staffs, to provide practical information on arc welding for the beginner, and to give hints on the welding of various kinds of steel and non-ferrous metals. The first six chapters describe the methods of welding the various kinds of joints in different positions. The remaining chapters deal with deep penetration welding, sheet metal work, the weldability of various metals and the methods of welding them. This book (price 2s. 6d. net) is an abbreviated version of the "Quasi Arc Welding Manual" and can be obtained from the address given above.

PROFESSIONAL PRACTICE IN ENGINEERING.—The Society of Engineers (Incorporated), a body founded to promote the science and practice of engineering and protect the interests of the persons engaged therein, published in 1917 "Professional Practice in Engineering" for engineers engaged on consulting work. That booklet was revised by the Professional Practices Committee and the revised edition has now been published. Particulars are given of the qualifications necessary to warrant an engineer practising as a consulting engineer; of the rules of conduct governing professional practice; of the minimum fees usually charged by consulting engineers; and of the terms and conditions usually associated with such charges. In an appendix a simple form of agreement is given. The booklet may be obtained from the Society at 17, Victoria Street, S.W.1, at a price of 2s. for members or 3s. 6d. for non-members.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Association of Supervising Electrical Engineers

Mon., Jan. 10th.—S.E. LONDON BRANCH: S.E. London Tech. College, Lewisham, "The Man and His Job," No. 3, "The Consumer's Engineer," A. E. Marlow, 8 p.m.

Tues., Jan. 11th.—BRISTOL BRANCH: Grand Hotel, Bristol, "The Fuel of the Future," P. Honey, 7 p.m. ——S.W. LONDON BRANCH: Compton Hall, Compton Road, Wimbledon, "The Case Against Fluorescent Lighting," G. V. Downer, 7.30 p.m.

Thurs., Jan. 13th.—N. LONDON BRANCH: St. John's Hall, Hoppers Road, Palmers Green, "Electric Resistance Welding," J. R. Bateman, 7.30 p.m.

Fri., Jan. 14th.—CREWE BRANCH: Crewe Arms Hotel, Crewe, "Induction Smelting Furnaces," C. Osborne, 7 p.m.

Chemical Society

To-day, Jan. 7th.—Engineers' Club, Albert Square, Manchester, "Production of Acetylene from Hydrocarbons," H. Steiner, 6.45 p.m.

Derby Society of Engineers

Mon., Jan. 17th.—School of Arts, Green Lane, Derby, "Developments in Locomotive Engineering," R. G. Jarvis, 7.15 p.m.

Incorporated Plant Engineers

To-day, Jan. 7th.—BIRMINGHAM BRANCH: Imperial Hotel, Temple Street, Birmingham, "Twenty Years' Progress with Bucket Type Excavators," S. L. McKay, 7.30 p.m.

Tues., Jan. 11th.—E. LANCS. BRANCH: Engineers' Club, Albert Square, Manchester, "Fire Appliances," H. Hoyle, 7.15 p.m.

Thurs., Jan. 13th.—Y.M.C.A., Shakespeare Street, Nottingham, "Prevention of Injury from Dust Explosions in Industry," D. Matheson, 7 p.m.—NEWCASTLE-UPON-TYNE BRANCH: Crown Hotel, Newcastle-upon-Tyne, "Principles of Lubrication," W. J. Frier, 7.30 p.m.

Institute of British Foundrymen

Sat., Jan. 8th.—NEWCASTLE BRANCH: Neville Hall, Newcastle-upon-Tyne, Branch President's Night, 6 p.m.——WEST RIDING OF YORKS BRANCH: Tech. College, Bradford, Prizewinning paper, S. W. Wise Memorial Competition, 6.30 p.m.

Mon., Jan. 10th.—SHEFFIELD BRANCH: Royal Victoria Hotel, Sheffield, "Do You Use Your Cost System?" R. L. Lee, 7.30 p.m.

Tues., Jan. 11th.—SLOUGH SECTION: High Duty Alloys, Ltd., Slough, "Some Special Examples of Light Alloy Founding," H. W. Keeble and Mr. Caven, 7.15 p.m.

Wed., Jan. 12th.—LANCASHIRE BRANCH: Engineers' Club, Albert Square, Manchester, "Venting of Cores and Moulds," D. Killingworth, 7 p.m.

Thurs., Jan. 13th.—LINCOLN SECTION: Tech. College, Lincoln, "Some Problems of a Small Jobbing Foundry," E. A. Phillips, 7.15 p.m.

Fri., Jan. 14th.—MIDDLESBROUGH BRANCH: Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough, "The Production of Basic Electric Steel for Castings," L. Johnson, 7.30 p.m.

Sat., Jan. 15th.—BIRMINGHAM BRANCH, STUDENTS' SECTION: Visit to Works of the Incandescent Heat Company, Ltd., Smethwick, 9.30 a.m.

Institute of Marine Engineers

Tues., Jan. 11th.—85, Minories, E.C.3, "Methods of Non-Destructive Testing of Large Marine Forgings and Castings," J. Rhodes, T. H. Arnold and H. S. Peiser, 5.30 p.m.

Institute of Navigation

Mon., Jan. 10th.—Royal Geographical Society, 1, Kensington Gore, S.W.7, three films on radio systems, commentary by R. F. Hansford, 5.30 p.m.

Institute of Petroleum

Wed., Jan. 12th.—Mansion House, 26, Portland Place, W.1, "Measurement of Kinetic Boundary Friction," F. T. Barwell and A. A. Milne, 5.30 p.m.

Institute of Road Transport Engineers

Mon., Jan. 10th.—SCOTTISH CENTRE: North British Hotel, Edinburgh, "Metal Failures," R. Stong, 7.30 p.m.

Institute of Transport

Mon., Jan. 17th.—Jarvis Hall, 66, Portland Place, W.1, "An Economist Looks at Transport," Roland Bird, 5.30 p.m.

Institute of Welding

Thurs., Jan. 13th.—S. LONDON BRANCH: Institute of Marine Engineers, 85, Minories, E.C.3, "New Methods of Oxygen Cutting Stainless Steels," E. Seymour Semper, 6.30 p.m.

Institution of Civil Engineers

Tues., Jan. 11th.—Great George Street, S.W.1, "Site Investigations, including Boring and Other Methods of Sub-Surface Exploration," H. J. B. Harding, 5.30 p.m.

Thurs., Jan. 13th.—BIRMINGHAM AND DISTRICT ASSOCIATION: James Watt Memorial Institute, Great Charles Street, Birmingham, "The Use of Light Alloys in Structures," R. A. Foulkes, 6 p.m.

Fri., Jan. 14th.—N.W. ASSOCIATION: College of Technology, Manchester, "Recent Developments of Pre-Stressed Concrete Structures," K. W. Mautner, 7 p.m.

Institution of Electrical Engineers

Mon., Jan. 10th.—LONDON STUDENTS' SECTION: Savoy Place, Victoria Embankment, W.C.2, "Electrical Methods of Recording Transient Pressures," M. T. Cree, 7 p.m.——N.E. CENTRE: Neville Hall, Westgate Road, Newcastle-upon-Tyne, "Factors Influencing the Design of High-Voltage Air-Blast Circuit Breakers," C. H. Flurscheim and E. L. L'Estrange, 6.15 p.m.

Tues., Jan. 11th.—N. MIDLAND CENTRE: Yorkshire Electricity Board, 1, Whitehall Road, Leeds, 1, "The Lightning Protection of High-Voltage Transmission and Distribution Systems," H. M. Lacey, 6.30 p.m.—— MEASUREMENT AND RADIO SECTION: Savoy Place, Victoria Embankment, W.C.2, "Double Ratio A.C. Bridges with Inductively Coupled Ratio Arms," H. A. M. Vanderlyn; "A Direct Capacitance Aircraft Altimeter," W. L. Watton and M. E. Pemberton, 5.30 p.m.

Wed., Jan. 12th.—RADIO SECTION: Savoy Place, Victoria Embankment, W.C.2, "Some Aspects of Design of Balanced Rectifier Modulators for Precision Applications," and "The Effects of an Unwanted Signal Mixed with a Carrier Supply of Ring-and-Cowan Modulators," D. G. Tucker, 5.30 p.m.

Thurs., Jan. 13th.—Savoy Place, Victoria Embankment, W.C.2, "The Medical and Psychological Aspects of Electric Shock, and some of the Nervous Complications," Macdonald Critchley, 5.30 p.m.

Institution of Engineering Inspection

Tues., Jan. 11th.—LEEDS BRANCH: Hotel Metropole, Kings Street, Leeds, "Non-Destructive Testing," J. H. Turner, 7.30 p.m.

Thurs., Jan. 13th.—N.W. DISTRICTS: Engineers' Club, Albert Square, Manchester, "Non-Destructive Tests on Welded Structures," G. S. Plant, 7.30 p.m.

Institution of Engineers and Shipbuilders in Scotland

Tues., Jan. 11th.—39, Elmbank Crescent, Glasgow, "The History of the River Clyde and the Development of the Port of Glasgow," W. F. Robertson, 6.30 p.m.

Institution of Heating and Ventilating Engineers

Wed., Jan. 12th.—LONDON AND DISTRICT ASSOCIATE MEMBERS' AND GRADUATES' SECTION: Gas Industry House, 1, Grosvenor Place, S.W.1, "Centrifugal Fan Applications and Design," R. K. Cornell, 6.30 p.m.

Institution of Mechanical Engineers

To-day, Jan. 7th.—Storey's Gate, St. James's Park, S.W.1, "Rotary Motion," W. Abbott, 6 p.m.—— SCOTTISH BRANCH: Heriot-Watt College, Edinburgh, "Heat Engines," K. Baumann, 7.30 p.m.

Tues., Jan. 11th.—AUTOMOBILE DIVISION: Storey's Gate, St. James's Park, S.W.1, "Basic Problems in the Engineering of a Modern All-Metal Motor Body," E. S. White, 6 p.m.

Fri., Jan. 14th.—Storey's Gate, St. James's Park, S.W.1, "The Distribution of Load in Screw Threads," D. G. Sopwith; "Tensile Fillet Stresses in Loaded Projections," R. B. Heywood, 6 p.m.

Junior Institution of Engineers

To-day, Jan. 7th.—39, Victoria Street, S.W.1, film evening, "Wheels Behind the Wheels," introduced by H. Bromage, 6.30 p.m.

Mon., Jan. 10th.—N.W. SECTION: The Manchester Geographical Society, 16, St. Mary's Parsonage, Manchester, "Ships of the Fishing Fleet," R. Bayes, 7 p.m.

Fri., Jan. 14th.—39, Victoria Street, S.W.1, "The General Application of Gas and Coke for Domestic Heat Services," L. W. Andrew, 6.30 p.m.——WESTERN GROUP OF MEMBERS: Tech. College, Bath, "Astronomy and Engineering," H. Chatley, 7.30 p.m.

Manchester Association of Engineers

Fri., Jan. 14th.—Engineers' Club, Albert Square, Manchester, "Paper-Making Machines: Some Essential Factors in their Design, Construction and Operation," G. H. Sheldon, 6.45 p.m.

Newcomen Society

Wed., Jan. 12th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1, "Trevithick, Raistrick and the Hazledine Foundry, Bridgnorth," S. Morely Tonkin, 5.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders

Fri., Jan. 14th.—Mining Institute, Newcastle-upon-Tyne, "Tanker Design from a Stability Point of View," N. H. Burgess, 6.15 p.m.

Calendars and Diaries

WE acknowledge the receipt of calendars and diaries for 1949 from the undermentioned firms:

BRISTOL AEROPLANE COMPANY, Ltd., Filton, Bristol.

BRITISH JEFFREY-DIAMOND, Ltd., Wakefield.

RUSTON-BUCYRUS, Ltd., Lincoln.

MAVOR AND COULSON, Ltd., Bridgeton, Glasgow.

BRITISH ROPES, Ltd., Carr Hill, Doncaster.

K.L.M., ROYAL DUTCH AIRLINES, Holland.

GEORGE WAILES AND CO., Ltd., 382, Euston Road, London, N.W.1.

J. E. RAISTRICK, Ltd., Reliance Works, Park Royal Road, London, N.W.10.

WAYNE V. MYERS COMPANY, Ltd., 365, Chiswick High Road, London, W.4.

UNION-CASTLE MAIL STEAMSHIP COMPANY, Ltd., 3, Fenchurch Street, London, E.C.3.

BRITISH OVERSEAS AIRWAYS CORPORATION, Airways House, London, S.W.1.

NEW INSULATION COMPANY, Ltd., Gloucester.

BUTTERS BROS AND CO., Ltd., Glasgow.

SWEDISH LLOYD, Gothenburg, Sweden.

C. A. PARSONS AND CO., Ltd., Heaton Works, Newcastle-upon-Tyne.

BROOKHIRST SWITCHGEAR, Ltd., Chester.

ASHWELL AND NESBIT, Ltd., Barkby Road, Leicester.

THE GEAR GRINDING COMPANY, Ltd., Shirley, Birmingham.

ROLLS-ROYCE, Ltd., Nightingale Road, Derby.

WERKSPOOR N.V., Amsterdam, Holland.

ASSOCIATED EQUIPMENT COMPANY, Ltd., Southall, Middlesex.

ASSOCIATION OF BUILDING TECHNICIANS, 5, Ashley Place, London, S.W.1.

BRITISH TIMKEN, Ltd., Aston, Birmingham.

PLESSEY COMPANY, Ltd., Ilford, Essex.

THOMAS W. WARD, Ltd., Albion Works, Sheffield.

EDWARD WOOD AND CO., Ltd., 68, Victoria Street, London, S.W.1.

STEWARTS AND LLOYDS, Ltd., Broad Street Chambers, Birmingham.

D. NAPIER AND SON, Ltd., 211, Acton Vale, London, W.3.

BRITISH INSULATED CALLENDER'S CABLES, Ltd., Bloomsbury Street, London, W.C.1.

WM. R. SELWOOD, Southampton.

HALL HARDING, Ltd., Stourton House, Dacre Street, Westminster, S.W.1.

HOLMAN BROS., Ltd., Camborne.

MESSENT AND BOND, Ltd., 1, Clerkenwell Green, London, E.C.1.

SLIP PRODUCTS, Ltd., Coombe Bridge, London, S.W.20.

F. J. EDWARDS, Ltd., 359, Euston Road, London, N.W.1.

MIRRLEES WATSON COMPANY, Ltd., Glasgow.

COVENTRY VICTOR MOTOR COMPANY, Ltd., Coventry.

JOHN H. RIDDEL, Ltd., Glasgow.

NORTH BRITISH LOCOMOTIVE COMPANY, Ltd., Springburn, Glasgow.

BRITISH VACUUM CLEANER AND ENGINEERING COMPANY, Ltd., Leatherhead.

D. P. BATTERY COMPANY, Ltd., Bakewell, Derbyshire.

LE GRAND, SUTCLIFF AND GELL, Ltd., Southall, Middlesex.

Personal and Business

MR. W. T. AGAR has been appointed a director of B. and S. Massey, Ltd.

MR. JOHN G. LEGG, M.I.Mech.E., has been elected a director of J. Brockhouse and Co., Ltd.

MR. CHARLES LAWRIE, general sales manager, has been appointed a director of Vacuum Oil Company, Ltd.

MR. R. W. STOREY has been appointed deputy sales manager of the Brush Electrical Engineering Company, Ltd.

THE BOARD OF THE MANCHESTER SHIP CANAL COMPANY, has appointed Mr. H. J. Harwood as Cost Accountant.

MR. A. W. A. DICK-CLELAND, B.Sc., M.I.E.E., has been appointed a director of Lancashire Dynamo and Crypto, Ltd.

MR. C. HAYSEY has been appointed District Engineer, Newcastle, in the North-Eastern Region of British Railways.

MR. G. H. TAYLOR, Deputy Regional Director of the London Telecommunications Region, has retired after forty years' service.

THE Scottish Region of British Railways states that Mr. Alexander Penman has been appointed works manager at Germiston Works, Glasgow.

MR. V. RANDLE has been appointed district electrical assistant, Nottingham, for the Eastern and North-Eastern Regions of British Railways.

THE DOCKS AND INLAND WATERWAYS EXECUTIVE has appointed Mr. W. M. Hitchcock as Divisional Waterways Officer, in the North-Eastern Division.

RADIATION, Ltd., announces that Mr. J. F. Davies, chairman since 1941, has retired from the board. He is succeeded by the present deputy chairman, Dr. Harold Hartley.

THE ROCKWELL MACHINE TOOL COMPANY, Ltd., Exhibition Grounds, Wembley, has been appointed sole selling agent in the United Kingdom for the Monarch-Keller form-turning machine.

MR. E. AUSTYN REYNOLDS, Mr. J. H. Catling, and Mr. W. H. Bowman have been appointed executive directors of T.I. Aluminium, Ltd., the new subsidiary company of Tube Investments, Ltd.

THE Admiralty announces that Mr. H. E. Newnham, R.C.N.C., has been appointed warship production superintendent, Northern Ireland area, and principal (ship) overseer, Harland and Wolff, Ltd., Belfast.

MR. G. KENNEDY STOTT has been appointed general manager of the General Electric Company (Burma), Ltd., in succession to Mr. J. Paxton, who will shortly join the G.E.C. organisation in this country.

MR. A. H. LANGFORD, director and general manager of Heenan and Froude, Ltd., has been appointed a director of three subsidiary companies, Court Works, Ltd., Industrial Waste Eliminators, Ltd., and the New Destructor Company, Ltd.

WILD-BARFIELD ELECTRIC FURNACES, Ltd., states that the address of its Sheffield office is now 4, Paradise Square, Sheffield, 1 (telephone, Sheffield 22776). The office of its associated company, G. W. B. Electric Furnaces, Ltd., is at the same address.

A Seven-Day Journal

Lectures on Nuclear Power Problems

THE Ministry of Supply has announced that arrangements are being made for a course of seven lectures on the subject of "Scientific and Engineering Problems of Nuclear Power." These lectures will be given by Dr. O. Buneman and Mr. J. Diamond, Wh.Sc., A.M.I. Mech. E., of the Atomic Energy Research Establishment, Harwell, at the Imperial College of Science and Technology, Electrical Engineering Department, South Kensington, S.W.7, at 3.45 p.m. on Thursdays, beginning January 20th. The lectures will deal with the supply and demand of nuclear fuel, general features of fission reactors, deleterious effects associated with nuclear reactors, heat removal and utilisation, constructional aspects of reactors, and control and instrumentation of reactors. It is stated by the Ministry of Supply that admission to the lectures will be free to sui able students of the Imperial College and to inter-collegiate students. To others a charge of 31s. 6d. will be made for the course of seven lectures, and those wishing to attend are asked to apply to the Deputy Registrar, City and Guilds College, Exhibition Road, S.W.7.

Combined Heat and Power Supplies

THE Institute of Fuel is arranging to hold in London on Tuesday, January 25th, and Wednesday, Apr.l 27th, two full-day conferences to discuss the subject of "Combined Heat and Power Supplies." In making this announcement, the Institute says that the paradox of the fuel and power situation in this country at present is that, whereas the production and distribution of fuel are being planned on a national scale, consumption is largely unco-ordinated. The result is that a surplus of energy in one industrial undertaking is often wasted when it might be transferred to a neighbouring works at which there is a temporary deficiency. It is claimed that the overall result of such linkages would be a saving of many millions (f tons of coal a year, representing a substantial contribution to national recovery. The problem of combined heat and power supplies has been under discussion by fuel technologists for many years, and the aim of the two conferences is to co-ordinate the known data and provide a basis for investigation in one or more geographical areas. Both the conferences will be held at the Institution of Mechanical Engineers, Storey's Gate, S.W.1. At the first, on January 25th, three papers will be presented as follows: —"Elements of Heat Balance," by Mr. J. Edward; "Heat Balances in Practice," by Mr. J. B. M. Mason and Mr. L. Clegg; and "Steam Peaks," by Dr. E. G. Ritchie. There will be two sessions beginning at 10 a.m. and 2 p.m. The conferences will be public and open to all interested, and those wishing to attend the first are invited to apply for tickets to the Institute of Fuel, 18, Devonshire Street, London, W.1, not later than January 17th. A buffet luncheon will be available at 5s. a head.

The Corrosion of Cast Iron Pipes

A DEPARTMENTAL committee has been appointed by the Minister of Health to investigate the problem of corrosion in cast iron water pipes. For some time past, the Ministry says, evidence has been accumulating of the rapid external corrosion of cast iron and spun iron water pipes, especially those laid in clay subsoils containing sulphates. One result has been rather a large number of bursts, and in some instances water mains have had to be replaced only ten years after being laid. Lieut.-Colonel F. G. Hill, Ministry of Health, is chairman of the committee, the other members being Mr. G. M. Binnie, Institution of Civil Engineers; Mr. J. C. O. Burns, Department of Health for Scotland; Mr. H. J. Escreet, Institution of Gas Engineers; Dr. J. C. Huds n, Iron and Steel Institute; Dr. A. Key, Ministry of Health; Mr. R. W. Melvin, British Waterworks Association; Mr. E Morgan and Mr. E. Wharton, Cast Iron Pipes Association; Mr. W. P. Rees, and Dr. W. H. J. Vernon, Department of Scientific and Industrial Research; Mr. C. A. Risbridger, British Waterworks Association; Mr. L. C. Whiskin and Mr. J. Noel Wood, Institution of Water Engineers; Mr. E. H. Williams, Ministry of Works; and Mr. J. B. Windsor-Richards, Ministry of Supply.

Transport in East Africa

A CONFERENCE to consider matters relating to transport in East Africa was concluded in London at the end of last week. It was convened by the Secretary of State for the Colonies Mr. A. Creech Jones, and among those who took part in it were the Chairman of the East Africa High Commission, the Acting Governor of Tanganyika, the Commissioner for Transport in East Africa, and representatives of the Overseas Food Corporation, the Colonial Development Corporation and the East African Conference Lines. The present position of the port of Dar es Salaam was reviewed, and consideration was also given to ways and means of enabling it to carry a tonnage sufficient to meet the requirements of all port users, including the Overseas Food Corporation. The view taken by the conference was that the problem of Dar es Salaam resolved itself into two parts—the immediate handling of an increased volume of traffic and the more permanent matter of increasing the capacity to accord with the developing economy of the territories. It was stated that the existing 1460ft of quay was being extended by 500ft, but that no increase in the area beyond the quay could be made because of the close proximity of the town. It was also noted that the East African Transport Administration had decided to construct two deep-water berths at the port of Dar es Salaam, the first of which should be in operation at the end of 1951 and the second in 1952. In addition, the conference was informed that a technical committee in East Africa was investigating the possibilities of Dar es Salaam even being developed beyond the present contemplated extensions into a major port. On the general problem of the long-term development of communications in East and Central Africa, the conference noted a proposal to survey alternative routes which would provide a railway link between the Rhodesian and East African railway systems (the North-South link), and also the route from Broken Hill to Mikindani. The former survey is to be a comprehensive engineering survey accompanied by economic surveys of the areas which the railways are expected to serve, while the latter will be a quick reconnaissance survey to ascertain whether the Broken Hill to Mikindani route is likely to be a practicable proposition.

Speaking Traffic Signals

ON Tuesday, January 11th, we were invited by Speaking Signals, Ltd., of 10 and 12, Copthall Avenue, London, E.C.2, to attend a demonstration at E.M.I. Factories, Ltd., Hayes, Middlesex, of the speaking traffic signal, which has a special application to road and particularly to pedestrian safety. The apparatus, which is fully patented by Speaking Signals, Ltd., who will market and distribute it, has been developed and will be manufactured by E.M.I. Factories, Ltd. The recording device has been developed from the principle of the E.M.I. tape recorder and makes use of a small belt of "Emitape," carrying an appropria e cautionary message, which can be ingeniously synchronised with the changing lig ts usually used for traffic control, without in any way affecting their sequence or operation. Typical messages transmitted at the demonstration, which, it was pointed out, may be recorded in tones and accent most familiar to school children of any locality, were:—"Children, remember, look right, look left, look right again," or "Before crossing, look right, look left, look right again. Thank you." The apparatus is contained in a compact waterproof housing, which weighs approximately 30 lb and can be conveniently attached to a light signal standard. It can, moreover, be designed to operate alone with a timing device or in synchronous working with the normal traffic signal. Among those who attended the demonstration were officials of the Ministry of Transport, the Metropolitan Police, the Royal Safety First Society and the Road Research Council. While a priority is being given to the application of this new invention to safety on roads, it is also being adapted, we understand, to many other fields in industry and commerce in connection with every kind of scientific measuring or control instrument as a valuable link with a danger or datum line.

Iron and Steel Production

FIGURES published by the British Iron and Steel Federation on Wednesday morning last show that, despite the Christmas holiday, British steel production in December was maintained at an annual rate of 14,678,000 tons, compared with an annual rate of 12,646,000 tons in December, 1947. The weekly average output of ingots and castings in December was 282,300 tons, and pig iron production averaged 176,000 tons, which represented an annual output rate of 9,150,000 tons. Total production of steel ingots and castings in the year 1948 was, therefore, 14,877,000 tons, and therefore exceeded, with a handsome margin, the Government's revised target of 14,500,000 tons. The year's total was by far the highest annual output reached in the history of the British steel industry, the best year previously being 1939, when 13,222,000 tons were produced. The total output of pig iron in 1948 was 9,276,000 tons, or nearly 2,000,000 tons more than the quantity produced in 1947. Commenting on the figures, the British Iron and Steel Federation says that an outstanding feature of the year was the success of the industrial home scrap drive, launched by the iron and steel industry in October, 1947. It is added that raw material supplies are again likely to be the main factor affecting performance during this year.

The Thames Conservancy Board

IN his annual statement to the Thames Conservancy Board, on Monday, January 10th, Sir Jocelyn Bray, the Chairman of the Board, said that radioactive effluent from the atomic energy research establishment at Harwell had been discharged into the Thames on June 27th, and such discharge had continued intermittently. All possible precautions, Sir Jocelyn said, were being taken in order to ensure that the radioactive effluent did not exceed the tolerance figures laid down by the British Medical Research Council as being safe. He himself had visited Harwell and had been greatly impressed by the care which was taken in every di ection to avoid cause for complaint. The effluent was checked at three stages by the Ha well staff befo e discharge, and further checks were made by others, including the Conservators' analyst. The figures indicating the radioactivity of the effluent had been well within the safe limit, but the matter was continuing to be watched very closely. As regards general pollution, the Central Adv sory Water Committee had set up a pollution sub-committee, which had been sitting for two years. Evidence from all the interests concerned had been heard, and a draft report was now being considered. The Conservators had been concerned about the provision of adequate arrangements for sewerage and waste and surface water disposal in the new towns at Crawley, Bracknell and elsewhere, and representations had been made to the Ministries affected. The discharge of condenser water into the Thames from the new electricity power station at Kingston was being closely watched, but full results would not be known until the station was working at capacity.

The Navy of To-day and To-morrow

(By Our Naval Correspondent)

No. II—*(Continued from page 5, January 7th)*

Naval Strength and Future Needs

SINCE the publication of the Navy Estimates in February last, new construction in 1948 has done no more than strengthen the Canadian and Australian Navies with one light fleet carrier each, apart from the commissioning of the last of the four "Weapon" class destroyers. The concentration of shipyard resources on merchant ship construction, the need to rebuild our national economy, the desirability of incorporating in our new ships the results of development and research since the war, and the difficulty of finding trained complements have all been contributory factors in slowing down the completion of the ships begun during the war.

With the cancellation of Their Majesties' trip to Australia and New Zealand, the "Vanguard" is being sent to the Mediterranean for a few months early in the year, and it seems very desirable that she should return there. For although task force operations are more likely to be the rule in the future than fleet actions, battleships may well form a component part of those task forces. It thus seems very desirable that in our two main concentrations of ships—in home waters and in the Mediterranean—there should be at least one battleship to operate in peacetime with the remainder of the fleets. With two of the remaining five employed in training, as at present, and the other refitting, probably the most effective, though not necessarily the most economical, use would then be made of those powerful ships.

Large fleet carriers are more expensive to maintain in commission than light fleet carriers, and provide little better sea and naval flying experience. It is probably therefore a wise policy to keep in reserve the majority of those we have. Of our six large fleet carriers, four are in reserve at the present time, one is carrying out training duties, and the sixth is purely a harbour ship, used for the training of new entries. Two others are still building.

Four of the seven existing R.N. light fleet carriers normally operate with the fleets—two in the Home Fleet and two in the Mediterranean. One is on loan to the French, and two are in reserve or employed on special duties. Of the ten shown in the Navy Estimates as building, one has since been transferred to the Royal Canadian Navy, and one to the Royal Australian Navy. One more when completed is also going to the R.A.N. Three of those still under construction have had little work done on them since the war.

But it is in cruisers and destroyers that the need for new construction will soon become urgent. The twenty-nine cruisers we have—to which must be added three laid down during the war and still und r construction—are all too few, even for peacetime requirements. The need for showing the flag in foreign waters for the purposes of trade and prestige—an impressive flag, not a flag worn by a frigate or a sloop—makes this class of ship very much in demand.

In time of war, we can hardly have too many cruisers. They will be required to work with task forces and it cannot be known how many task forces will be needed or what size they will be. But, above all, cruisers are essential for the control of our trade routes, particularly in focal areas of trade, which are the happy hunting grounds of the raider. He does not go to the vast ocean spaces to find his prey, but to those comparatively small areas through which ships have to pass in order to make a landfall or navigate a narrow channel.

We cannot, unfortunately, estimate the number of cruisers required for the defence of our trade routes in the light of the number of cruisers an enemy will have with which to attack them. For an offensively armed merchantman makes a formidable raider, and it is not difficult for an enemy to fit out and equip a large number of such vessels to attack trade. An armed merchantman is, however, no match for a cruiser, properly handled. Even if armed with guns of the same calibre, a cruiser has more of them and she is faster and better equipped in every way for fighting, because she was designed with that object in view. She is, indeed, the best type of vessel to deal with an armed merchantman without waste of effort. There can thus be no useful purpose in trying to estimate the number of cruisers we ought to have; we should have as many as our financial resources permit.

Destroyers, too, are required in large numbers. It is impossible to visualise a task force in which destroyers will not form an essential component. But it is as anti-submarine vessels that they will be most in demand in the early stages of a war, unless the decision is made in the meantime to design and build frigates or equivalent vessels, with high speed, to cope with the high submerged speeds of the future submarine.

To a large extent, the new "Weapon" class destroyer may be regarded as a genuine anti-submarine vessel. For she has a poor gun armament—poor, at any rate, in comparison with existing destroyer standards—but a powerful anti-submarine armament. None the less, she is a destroyer, and destroyers are very expensive to build. Our existing destroyers now number only 117—apart from the ten which are still under construction—and it is to be hoped therefore that the present policy of selling and scrapping this type of vessel will cease forthwith. No matter how old a destroyer is, she makes a first-rate anti-submarine vessel, because of her high speed and manœuvrability.

Russia is credited with at least 250 sub-submarines and she probably has many more. There is, of course, no reason to assume that she is ahead of other countries in developing the submarine; but the fact remains that high submerged speeds are a certainty of the near future and no longer a fantastic dream. The counter for the moment is only to be found in the destroyer, for the wartime frigate with her twenty knots is quite inadequate. It is, indeed, during the next year or two that the destroyer would seem to be most in demand for this purpose. For there are signs that a much cheaper vessel may be designed for anti-submarine duties before very long. As evidence, one has only to mention the gas turbine unit, and a much lighter hull of aluminium alloy. Each of these inventions is being tried out separately at the present time in two small vessels.

Personnel

The National Service Act, which came into force on January 1, 1949, even amended to lengthen conscript service to eighteen months, presents a difficult problem for the Navy. A man can be trained to become a reasonably efficient infantryman, or even some sort of an airman in eighteen months, but not a seaman. The Navy is essentially a long-service profession, and even the men who joined the Navy for seven years (with five years in the Fleet Reserve)—the minimum term of service before the war—were regarded as the weakest link in the chain. It must be emphasised, however, that the Fleet Reserve consists of a most useful body of men. They draw a retainer of 1s. a day and are obliged to do one week's training every alternate year. On the outbreak of war they are used to complete the complements of the large number of ships which are kept in reserve commission in peacetime, with just sufficient officers and men on board to maintain them in a state of efficiency. As a temporary measure "hostility only" men who served for not less than three years during the war are being allowed to join this reserve.

In a seagoing warship there are a great number of jobs which can only be done by fully trained ratings; there are also a lesser number of unskilled jobs, such as messengers, telephonists, side boys, &c., which are carried out by boys and ordinary seamen under training (after their period of training ashore) between the times when they are learning how to do the skilled jobs which will be required of them later on. If, then, a large number of additional unskilled men are embarked as part of the ship's complement, it will be impossible to fit them into the scheme of things.

On the other hand, the peacetime Navy has to be expanded at once on the outbreak of war. The skilled ratings are then diluted as much as possible, so that some can be made available to form the key men of the complements of the large number of extra ships required as escorts, anti submarine vessels, &c. But the bulk of the complements of these additional ships has, in the past, been provided by the Royal Naval Volunteer Reserve, a body of officers and men who like the sea, volunteer to serve in the Navy in time of war and receive a certain amount of naval training in peace. In future, however, unless the Navy takes a due proportion of men called up for compulsory service, there will be no one left for the R.N.V.R. For, although a conscript, after finishing his service, may choose a naval reserve force rather than the Territorials in which to do his reserve time, it is hardly likely that he will do so after having been a soldier or an airman for eighteen months.

This is the problem which the Minister of Defence must face, and has hitherto refused to face. At the moment, although long-service recruits are coming in well, the Navy has not yet recruited the number of long-service personnel required. And as there has been a heavy wastage recently, due to discharges on health and compassionate grounds, it has been possible to take in 6000 National-Service men this year—three times the token number that the Navy was originally prepared to take; and it is likely that it will be possible to take in even more during the year 1949–50. Nevertheless, this is purely a stop-gap arrangement, for the Navy, when it has recruited the required number of long-service personnel, will have no room for National Service men.

By December 31, 1948, the personnel had been reduced to something like its peacetime strength—139,000 men, with, in addition, some 8000 W.R.N.S. This has only been achieved by withdrawing several ships from foreign stations and immobilising a large part of the Home Fleet. The tide has now turned, however, and ships are gradually being brought back into commission. As has already been pointed out, the process of building up again must inevitably be slow until the annual intake of long-service recruits and, in consequence, the number of men and boys to be trained again becomes normal.

Present conditions are made still more difficult by the fact that the Navy now trains its own Naval Air Arm, apart from the preliminary flying training for which the R.A.F. is responsible. The personnel employed in that Arm represent over 30 per cent of the total numbers on Vote A, all of whom require intensive training. This, indeed, goes far to explain why no less than 65,000 officers and men are shore-based at the present time, and why it is necessary to add two aircraft carriers to the two modern battleships and other vessels now employed in training duties. We—and our foreseeable enemies—have not yet been told what the future strength of our Home Fleet and of our fleets and squadrons on foreign stations, in commission and immediately ready for war, is intended to be. But we may feel quite sure that no one is more anxious than the Board of Admiralty to finish with this abnormal period, which has more or less reduced the Navy to one vast training establishment, and to raise the fleet again to the strength required to meet the commitments laid down for it by the Government.

As part of their policy in making all concerned with aviation within the fleet an integral part of the Navy, the Admiralty has lately abolished the (A) Branch, and the officers of that branch are now being transferred, as appropriate, to the Executive and Engineering Branches. The new scheme entitles these officers to qualify for promotion to the highest ranks in the Navy. An offer has also been made of short-service commissions (five years) in the Electrical Branch to officers of the R.N.V.R. who were employed on technical duties connected with radar, wireless, air radio, air electrical or general electrical equipment. Other important measures in 1948, affecting personnel, include an older age of entry for Dartmouth cadets—they are in future to sit for the entrance examination between 15½ and 15¾; an extension in the age of entry for boys to 17½; and substantial increases in the rates of marriage allowance for officers and ratings and in the pay of skilled ratings. These increases should do a great deal to mitigate the hardships which both married officers and men were suffering as a result of the increased cost of living ashore, and to induce skilled men to re-engage for pension after serving their twelve years.

In view of the deterioration in the international situation, men with previous service in the Royal Navy and Royal Marines have now been asked to volunteer to join up in the event of emergency, without obligation of any sort to undergo training in the meanwhile. It appears, however, that little effort has been made since the war to persuade "hostilities only" men, on finishing their time, to join the R.N.V.R. Nominally, there are twelve permanent R.N.V.R. divisions distributed around our coasts with, in addition, four Air Squadrons, but the number of ratings is negligible. The officer situation is, however, more satisfactory, 70 per cent of requirements having enrolled.

The reconstitution of the Royal Naval Reserve still awaits an estimate of the requirements of the Merchant Navy. The Admiralty feel that it is no use enrolling Merchant Navy officers and men whose services cannot be spared in war. Some 600 pre-war R.N.R. officers have, however, volunteered to remain and are still regarded as being in the R.N.R.

A long-felt want has recently been supplied with the establishment of a Royal Marine Volunteer Reserve, and a Royal Marine Special Reserve. The latter places the Royal Marines on the same footing as naval ratings, in that a man can now join for a period of seven years' active service and five years in the reserve.

Maintenance

It is the Government's intention to replan our naval dockyards, most of which are inadequate to deal with modern conditions and have out-of-date equipment, with a view to their ultimate reconstruction on modern lines. Meanwhile, little has been done to repair the damage which they suffered during the war, owing to the present abnormal conditions of restricted labour, material and financial resources. All our dockyards have, however, been kept on an active service basis and, until the recent deterioration in the international situation, have been able to do a certain amount of commercial work, on repayment, as a result of reduced activity on naval shipbuilding and repairs.

A good deal of money has been spent since the war, and is still being spent, on the reconstruction of our naval base and dockyard at Singapore. This is a wise decision, in spite of the views expressed by some naval experts that the place is outmoded and indefensible. It is also argued that even when adequately defended from both land and sea attack, as it can be, and will be in the future, Singapore will always lack the third requirement of a good naval base—a hinterland with natural resources. For almost everything needed by the garrison has to be taken there by sea. This, however, applies equally to Gibraltar or Malta, whose safety has always depended on a superior fleet providing cover for replenishments and reinforcements.

In view of the very large number of ships laid up in reserve—many of them with no men on board—it is satisfactory to learn that the method of "pickling" their guns and other equipment, is proving remarkably effective. This method of "pickling," which is an adaptation of an American idea and has already been referred to in this journal, consists of padding the gun or other surface to shape and covering it with a layer of adhesive tape, on which is placed fishnetting. The whole is sprayed with a webbing liquid to form a cocoon, which is then covered with rubber latex and three coatings of halothene. A bag of drying agent is also inserted in the coating. Naval aircraft shipped abroad are now also being "pickled" in a similar way, halothene being sprayed on and a moisture-absorbing substance placed inside the aircraft.

Trials and Other Naval Activities

The Admiralty are leaving no stone unturned in their efforts to ascertain the effect on ships' structures of gunfire, underwater explosions and bomb explosions, both on and within a ship, to provide data for the future design of our ships and weapons. As far as possible the improvements in the design of ships and weapons found to be necessary as a result of these trials are being incorporated in ships already built. All classes of surplus warships—from battleships to submarines—are being used. The trials which commenced in 1945 were continued throughout 1948 and more trials are now planned to include further research into underwater explosion effects, bombing trials, trials of security against flash, the effect of a ship's gunfire on its own structure, and the effect of damage and flooding on the running of machinery in a destroyer.

Other trials have been in progress with a more peacetime purpose in view. These have led to the design and construction of a new 5½-ton anchor, which is no less than four times as efficient as older standard types of equivalent weight; and to the introduction of a diver's suit which enables a diver to work at approximately the crash-dive depth of a submarine. Descending from H.M.S. "Reclaim"—the new submarine rescue and deep-diving vessel—a diver recently descended to 535ft. A new type of life-saving raft, to carry ten men, is also being tried out to replace the old Carley float. The new float resembles a huge motor-tyre fitted with rubberised fabric and covered by a tent.

Apart from a submarine and aircraft exercise in the North Sea in May, which lasted only forty-eight hours, and in which the two battleships of the training squadron took part as target vessels, there was practically no naval activity in home waters throughout the spring and summer. It was not until the end of September that the Home Fleet became something of a fleet again, after being, to all intents and purposes, immobilised for a whole year, and sailed for a cruise to the West Indies and South African ports—a fleet of one battleship, three cruisers, two light fleet carriers, and twelve destroyers. Both for the purposes of giving seagoing training and experience to officers and men, and of showing the flag, the cruise was entirely successful and the ships received a wonderful welcome at every port of call.

Abroad, our skeleton squadrons on foreign stations have had an uneventful year apart from the somewhat dangerous situation at Belize, British Honduras, when "irresponsible Guatemalan elements" threatened the sovereignty of that colony.

A very unpleasant duty for the ships of the Mediterranean Fleet came to an end in May with the termination of the British Mandate in Palestine. The Civil Lord of the Admiralty and Mr. Eden paid a gracious tribute in Parliament to the splendid work of the ships in carrying out the Palestine patrol. Over forty-eight vessels carrying illegal immigrants had been intercepted.

To facilitate inter-Service co-operation in the Far East, the shore headquarters and the headquarters staff of the C.-in-C. British Pacific Fleet were recently transferred from Hong Kong to Singapore; and the title of C.-in-C. changed to C.-in-C. Far East Station. Hong Kong will, however, remain the operational training base of the station.

Third Programme Transmitting Station for Brighton District.—Since November 21st the new station at Kingston-on-Sea, mid-way between Brighton and Worthing, has been broadcasting the Third Programme which was formerly radiated from the original 100-W transmitting station in Dyke Road. The new transmitter, which uses mains power supply, has an output of 1kW. A self-supporting steel tower 150ft high is itself the transmitting aerial, so that a vertical receiving aerial should be used to get good reception. The earth system consists of a buried network of copper wires radiating from the transmitter building and covering most of the 3½-acre site. An aircraft-warning lantern at the top of the aerial tower is automatically switched on whenever visibility is poor.

British Railways in 1948

No. II—(*Continued from page 9, January 7th*)

TO continue our account of the work done by the Eastern and North Eastern Regions, on Sunday, December 5, 1948, an important scheme of replacement was performed at the east end of Sheffield Victoria Station, where there are a number of intricate crossings and signalling apparatus.

For this work plans were drawn up to make as simple as possible the operation of a complicated task. The plans provided that each sleeper and rail should be consecutively and clearly numbered and the use of different colours employed for signalling mechanism, so that when the time for re-laying came each portion of track could be clearly identified and fitted into its correct position.

When the component parts were completed the whole lay-out was assembled on an open site and each sleeper and portion of rail clearly numbered and the signalling apparatus painted in distinctive colours. Then, when it was decided that the new junction would meet requirements it was dismantled, loaded in sections on to trucks and conveyed to a site as near as possible to the east end of Victoria Station. Here it was re-assembled into thirty-two separate sections, each capable of being handled by two 10-ton steam cranes.

During the renewal operation sections of old track and crossings were dismantled and removed and new sections of the junction relaid in the vacant positions. As the work progressed each section was aligned and joined, and the track ballasted into a first-class running condition. At the same time, signal fitters were engaged in linking up the new mechanism with the signal-box. Opportunity was taken to introduce modern track circuiting.

The new junction, which incorporates 60 tons of rails, 35 tons of castings, 250 tons of ballast and 1650 cubic feet of timber, includes thirty-five sets of crossings and rail switches.

London Midland Region

In addition to the re-laying of many miles of track during the year several works of some magnitude have been started on the London Midland Region of British Railways.

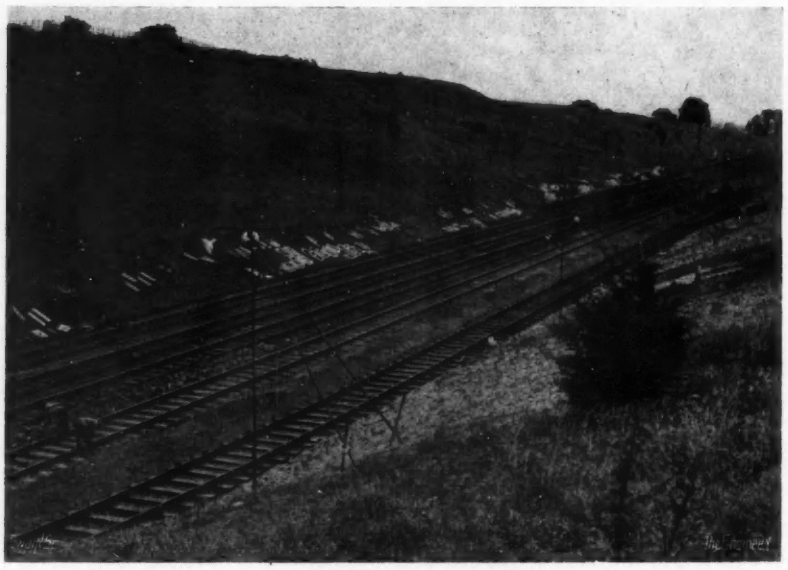
One of the larger works started was the modernisation of the up side of the Toton marshalling yard between Nottingham and Derby. In this yard, which is the keypoint for the reception of traffic from the North Midland coalfields, some 2700 coal wagons are marshalled daily for the south, east and west of England. The down side of the yard was completely modernised and mechanised in 1939 and modernisation of the up side now in hand will enable some 500 to 600 wagons to be shunted and marshalled daily.

The scheme of improvement involves the provision of arrival lines of adequate length, together with special signalling equipment to expedite the movement of wagons over the hump, whence they run down to sorting sidings. Power-operated brakes are being installed to slow down the wagons as they run into the sidings. Power-operated points will facilitate and speed sorting and, from a new control tower, operators will be able to control the movement of wagons into the sidings. Increased storage siding accommodation is being provided together with improved lay-out of marshalling and departure facilities. For night working electric lighting is to be installed throughout the yard and instructions from the control tower will be transmitted by loudspeakers.

At Denbigh Hall, on the London-Rugby line, a rapid piece of track renewal was carried out between 4 p.m. on Saturday, July 10th, and Monday, July 12, 1948. At this point the four tracks run in a deep clay cutting and in 1940 a serious slip occurred on the west bank of the cutting, alongside the down fast line. At the time, the slip was dealt with by trimming back the slope to a flatter angle, but it was not possible then to deal with the formation under the fast lines. Water pockets in this formation kept the clay soft, and although ash ballast was used to blanket the clay, track maintenance was very difficult and permanent speed restrictions had to be imposed.

The work of formation renewal covered a length of 220 yards under both fast lines and involved the excavation of 1500 cubic yards of clay and ashes to a maximum depth of 4ft below rail level.

A layer of fine sand 4in thick was spread over the new formation and mixed sand and gravel was then laid to an average depth of 2ft 6in. Granite ballast was then placed on this filling to carry the tracks.



Track Renewal at Denbigh Hall

To do this work in the forty-nine-hour possession of the fast lines, mechanical plant, including four draglines and two bulldozers, was used. In the photograph we reproduce of the site of the track renewal before work began, a temporary siding which was laid down adjoining the down fast line can be seen in the foreground.

At the end of September the track was relaid in the double-track, 3-mile long, Standedge tunnel between Manchester and Sheffield. For this work the track re-laying equipment of the Southern Region was used and with it some 4086 yards of prefabricated track were laid at high speed.

In the course of a tour of Cheshire and Lancashire in October, Sir Cyril Hurcomb, chairman of the British Transport Commission, announced important rebuilding schemes to be carried out at Crewe, Manchester and Liverpool. The scheme at Crewe provided for the complete modernisation of the north motive power depot at an ultimate cost of £500,000. The first stage of the work, costing £65,000, began in October, and will take some fifteen months to complete. It comprises the provision of a new coaling plant, an ash-handling plant, and a 70ft diameter turntable.

It is of interest to record that the Region used precast concrete jack arches to provide a new floor to the bridge, carrying the Euston-Carlisle main line over Middlewich Street at Crewe. Originally this 36ft span structure consisted of a steel centre and face girders, steel cross beams, steel rail-bearers, and a pressed-steel trough floor. As the main and cross girders were found to be in good condition and of sufficient strength to carry an additional dead load it was decided to lay a concrete floor and a ballasted sleeper track to support the permanent way. The trough floor and steel rail bearers were removed and precast jack arches in short lengths were inserted between the cross beams and concrete laid over them. As these jack arches could not be placed between the cross girders in one piece they were made in halves with a joint at the crown. This work took six weeks to complete and was carried out on two lines at a time to reduce the line occupation time to a minimum.

In April, reconstruction work on the roof of New Street Station, Birmingham, which was begun in 1945, was completed and the large arch-type wrought iron roof was replaced by individual platform roofs. The original roof was built in 1852, and consisted of thirty-six wrought iron bow-string trusses, 24ft apart and forming a continuous 840ft roofing. The original trusses varied in span from 212ft to just under 191ft, and their removal involved a number of problems. For the work of removing the first nine trusses tubular scaffolding was built up from the railway tracks, and the remainder of the trusses were removed by the use of two travelling gantries, which spanned the station across the tracks.

Scottish Region

A notable piece of work completed in the Scottish Region during 1948 was the modern-

isation of the motive power depot at Polmadie, in the southern outskirts of Glasgow. This depot is now one of the most up-to-date of its kind in the country. Its particular features—the locomotive coaling plant and the ash-handling equipment—were described in our issue of August 20, 1948.

The coaling plant, which is of the container hoist type, has two 100 and one 200-ton bunkers. The container is filled with coal from incoming wagons and is elevated to deposit its load into the appropriate bunker, which is determined by preselector switches by the plant operator. Locomotives are coaled on three sets of rails below the bunkers, and the coal is fed through the bunker outlets by jigger feeders designed to pass coal at rates from 60 to 120 tons an hour.

For the ash-handling plant a group of four parallel ashpits, each 190ft long, has been built between the tracks. Locomotives drop their ashes through grids into the pits in which they fall on to conveyor belts submerged in water-filled troughs. By means of other belts the cooled ashes are elevated and deposited into a reinforced concrete bunker which straddles a rail siding. This bunker is designed to take 50 tons of ashes and its contents can be dropped through bottom doors directly into wagons.

Southern Region

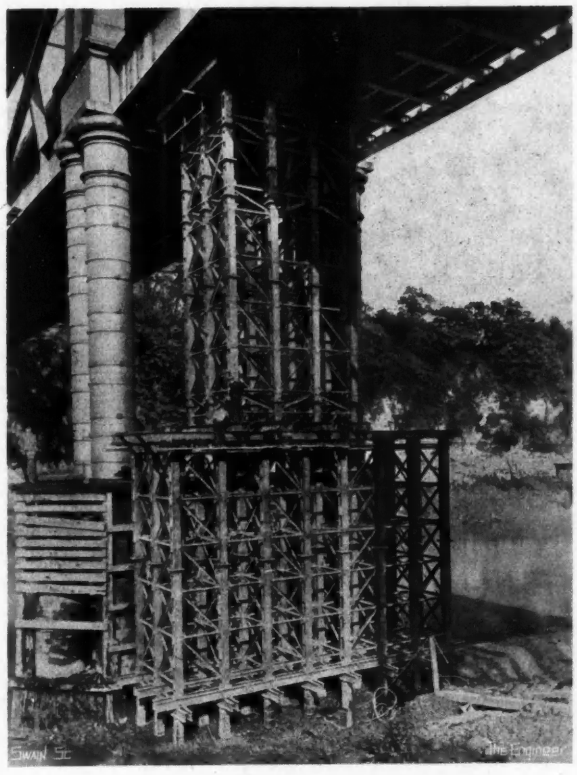
On the Southern Region two major engineering works have been carried out, in addition to the normal track renewal and maintenance programme. The first of these works was carried out early in the year and involved the complete renewal of track and ballast on both the up and the down lines in the Polhill tunnel. This tunnel, which is 1½ miles long, is situated on the boat train route to Tonbridge and Dover, between Knockholt and Dunton Green. The work undertaken also included the deeper reballasting of the centre section of the tunnel and the provision of a new drainage system.

Normally the amount of work involved at Polhill would have taken at least twenty-six week-ends and necessitated severe speed restrictions to all trains throughout the whole period. In order to lessen the prolonged inconvenience which would have been occasioned to passengers, it was decided to close the tunnel to traffic and complete the whole job in three weeks by working double shifts and using modern mechanical plant. Amongst the plant used was an interesting new track-laying machine, which is shown in the Supplement and was illustrated and described in The Engineer of March 26, 1948.

Work on the tunnel was completed in three weeks and it was reopened to service on March 22nd. During this period 1188 tons of rails, chairs and sleepers and 4700 tons of ballast were removed and replaced by similar tonnages of new material. In the course of the work the new machine laid 60ft lengths of preassembled track at a maximum speed of one every three minutes, and, on an average, thirty-four lengths in four hours.

This track-laying equipment was again used on Monday, July 19th, when the whole of the 840ft track adjacent to No. 5 platform at Waterloo Station was relaid between the morning and evening rush-hour periods.

During the latter part of the year, between November 25th and December 10th, the track and ballast on the up line in the 2-mile-long Sevenoaks tunnel was removed and replaced. The track in this tunnel, the longest on the Southern Region, requires re-railing every four years and complete track renewal and ballasting every eight years. Normally the work of re-laying the up line would have taken four week-ends of short possession and resulted in the temporary dislocation of traffic over a longer period. The use of track-laying and ballast-packing machines made the early completion of the work possible with two slightly longer week-end possessions.



Trestling under Chepstow Bridge

Western Region

Probably the most interesting piece of work in the Western Region during the year was the partial reconstruction of Brunel's famous bridge over the River Wye at Chepstow. This double-track bridge was built in 1852 and consists of a 300ft span supported on queen post trusses over the river and three 100ft spans at the Chepstow end. The work of reconstruction involved the renewal of the superstructures of the three land spans.

The wrought iron plate girders of the land spans were continuous over the three 100ft openings. The spans are of the through-type, and the superstructures for each track are separate. The old girders were remarkably light and over a length of 100ft weighed only 17 tons, although they were 7ft 6in deep. Their top flanges were of triangular box-form with the top plates curved in section, and some of the web plates were only ¼in thick. In their original form, there were only four stiffeners in a length of 100ft, and although additional stiffeners were added in more recent years, certain distortions developed in the web plates. It was therefore ultimately decided to renew the spans.

In the new spans, the main girders are not continuous, though the through-type construction, dictated by the pier cylinders, has been retained with the main girders at the same centres as the old ones. The decking consists of flat steel plating on stringers and cross girders and, in all, some 600 tons of steel has been used in the new spans.

For the reconstruction work the engineers were first given complete occupation of the down line, whilst single-line working continued on the up line.

Standard military unit steel trestling was erected under the bridge to support the new girders during erection. Under the third span, which is over the water at high tide, the trestling, 75ft high, was supported on timber piles driven into the river bed. This trestling can be seen in the photograph we reproduce herewith. The trestling under the other two spans was founded on timber cribs on the dry ground. Over the piles furthest from the bank, the first 32ft of the trestling was built for the full width of the bridge; above that and elsewhere the trestling was erected under the down line side of the bridge only and later skidded across under the up line spans.

In each case, construction started on the third span and progressed towards the abutment. The new main girders, in pairs, loaded on special trolleys, were pushed forward on to the bridge by a locomotive. There they were supported on the trestling and skidded laterally to a temporary position at 10ft 6in centres. This left room for a 3-ton travelling crane to work in, and after the timber decking had been removed the old cross girders were burned through near their ends and lifted away by the crane. The new main girders were then braced together and, with rails laid on their top flanges, they were used as a runway for twelve travelling beams from which the old main girders, gas-cut into lengths of about 15ft, were slung as shown in the photograph reproduced on the next page. These pieces of the old girders were lifted away by a crane working on the adjacent span, the more distant pieces being traversed in pairs along the runway to bring them within reach of the crane.

The new main girders were then skidded laterally to their final centres (and, in the case of those of the third spans, longitudinally 3ft 6in into pockets in the cast iron tower supporting the ends of the truss spans) and lowered on to bedplates inside the tops of the pier cylinders.

The new cross girders and steel decking, with the stringers fixed to it in units, were placed in position and, after riveting up, cement concrete was laid on the deck and covered with standard waterproofing.

In addition to the renewal of the superstructures of the land spans, the piers were strengthened by the addition of mild steel bracing between the cylinders. Work on the down line spans was completed in nine weeks, the line being reopened for traffic

on August 8th, and the engineers given occupation of the up line on the same date.

In this region also good progress has been made in connection with the extensive railway system, which will serve the new strip mill at Margam, Port Talbot. Up to the present, more than half the permanent way, which will comprise 7 miles of running lines and 15 miles of sidings, has been laid, and the earthworks, totalling 500,000 cubic yards, are nearly completed.

Work is proceeding on the construction of a viaduct of thirteen spans and another of three spans, five overbridges, and two underbridges. With the exception of the underbridges the structures are carried on piled foundations and for them more than 1000 piles, ranging in length from 15ft to 50ft, have been driven.

London Transport

In November some 10 miles were added to the length of the Central Line of London Transport's system, when new extensions were opened to the public at the eastern and the western ends of the line. At the western end the line was extended from Greenford to West Ruislip, and at the eastern end from Woodford to Loughton, and from Woodford via the Grange Hill loop to Hainault.

On the western extension four new stations, Northolt, South Ruislip, Ruislip Gardens, and West Ruislip, were built on the down side of British Railways, Western Region, London to Birmingham Line. At the eastern end the new extensions, in addition to extending the Central Line from Woodford to Buckhurst Hill and Loughton, also completed the electrification of the northern half of the Hainault loop by bringing Roding Valley, Chigwell and Grange Hill into the scheme. Whereas, on the Ruislip extension new electrified tracks and new stations were built, the work at the eastern end consisted of electrifying the existing Eastern Region tracks and adapting them for electric train operation. At Loughton there is now a platform interchange with Eastern Region steam trains to stations further east on the line to Epping and Ongar.

Throughout the western extension, new running tracks in 300ft welded lengths were laid and current rails, initially welded into similar lengths, were site-welded into lengths of half a mile. As part of the scheme of general improvement, a new car depot between Ruislip Gardens and West Ruislip, containing 9 miles of sidings, was put into service. This siding provides accommodation for nearly 500 cars, 184 of them under cover.

It is of interest to note that the concourse at Gants Hill Station on the Central Line was finally completed and opened to the public in April last. The station was opened at the time the extension was put into service in December, 1947, but work on the concourse was not fully completed. This concourse is a fine example of engineering skill and runs for a distance of 150ft from the foot of three escalators serving the platforms. It is 20ft wide and the tip of its domed ceiling, which is 20ft above platform level, is supported by sixteen pillars.

Girder Renewal on Chepstow Bridge

Coal in 1948

By Sir RICHARD A. S. REDMAYNE, K.C.B.

No. II—(*Continued from page 15, January 7th*)

Proposals by a Joint Production Committee

ON October 7th the Minister of Fuel and Power met the N.C.B. and the Executive Committee of the National Union of Mine Workers and addressed them in private on the subject of Britain's serious coal output situation. As a result of the proposal of Mr. Will Lawther, the President of the Union, it was agreed that a joint committee of the Board and the Union be appointed to recommend precise steps for rectifying the situation, the committee to be composed of six members of each with a senior civil servant as chairman. The committee reported within a few weeks of its appointment. Their recommendations included measures to bring about a greater increase in the number of men engaged on work on the face, joint attendance committees to secure more regular attendances at work, a drive to get full implementation of the five-days week agreement, and a joint effort to persuade the men to carry out more effectively the extended hours agreement. But the majority of the districts (union areas) turned down the recommendations either in whole or in part. The opposition was chiefly aroused against the proposal for joint attendance committees with power to recommend fines.

Finally, the miners' leaders, faced with open revolt in the majority of the coalfields, dropped that part of the plan which related to empowering pit committees to fine and dismiss habitual absentees and decided, instead, to invite each coalfield to submit its own plans for dealing with persistent absentees. These proposals will be discussed with the Coal Board by the miners' representatives on the joint production committee and a further report be submitted to the National Executive. In most of the coalfields the other proposals for increasing output, e.g., working bigger stints, putting more men at the coal face and the employment of more foreign labour, were agreed upon.

The Quality of our Coal

I cannot do better than repeat here the criticism made in a leading article in The Engineer of July 21, 1947, to the effect that the coal consumed by public utility concerns in the South of England, gas and electricity generation works, is largely seaborne, and if that coal contains from 15 to 20 per cent of dirt—and more has been alleged in some cases—whereas the inherent ash and irreducible dirt should not exceed 5 per cent, from 10 to 15 per cent of the cargo is taken up with matter which is of no practical use in the production of gas and electricity. In the case of land transport the same proportion of each truck of coal is equally wasted, and this at a time when every ship and wagon possible should be made available for carrying foodstuffs and other substances vital to the nation. The increase of dirt in coal sent for consumption is causing alarm. Mr. L. Gray, of the National Engineers Association, speaking before the T.U.C., on September 10th last, stated that there was 10 per cent more ash in coal now than in 1937. Part of the long-term plan of the N.C.B. is the installation of screening and coal washing plants on a large scale. Some two hundred schemes are under consideration, but the work will take several years to complete.

The cost of handling millions of tons of useless material and the high wages paid for raising it to the surface and carrying it

on the surface has been estimated to amount to £50,000,000 per annum.

Mechanisation

The Ministry of Fuel and Power statistical digest for 1946 and 1947, which was published on November 13, 1948, showed that there had been an increase in mechanisation at the pits. The percentage of coal cut by machines which was 59 per cent in 1938, rose to 72 per cent in 1945, 74 per cent in 1946, and 75 per cent in 1947. The proportion of coal carried in conveyors rose from 54 per cent in 1938 to 71 per cent in 1945, and 75 per cent in 1947, and the percentage of coal power-loaded, which was negligible in 1938, rose from 1·3 per cent in 1945 to 2·5 per cent in 1947. A welcome fact is the decrease in the number of horses and ponies employed at the collieries. It has shown a steady decrease over a number of years. In 1938 the number employed was 32,182, and, in 1947 only 21,013. This change is indicative of the extent to which mechanisation of underground haulage has extended, more particularly in subsidiary or secondary haulage in the proximity of the coal face.

With regard to power-loading of coal at the face, we are as yet far behind the U.S.A., where, according to Mr. James Boyd, Director of the Bureau of Mines, coal mechanically loaded in mines had risen from 20 per cent in 1937 to 59 per cent in 1948. But the American type of face-loader is not widely applicable to our collieries, where we have thinner seams and a different method of working, but there is room for an increased use of some of our own machines, designed to meet these conditions.

In February it was stated that the N.C.B. had ordered 152 fully flame-proof diesel locomotives for service underground in British pits, comprising four-wheel and six-wheel types of 65, 70 and 100 h.p. It was the largest order for mine diesel locomotives ever placed in any country. This is in line with the Reid Report regarding haulage improvement and is part of the £9,000,000 programme. These locomotives are valued at £750,000.

Skip winding of minerals has for long been in use, but in Great Britain has seldom been applied to the winding of coal. At Mansfield Colliery it has been introduced. In a paper read before the Midland Counties Institute of Engineers, on July 21st last, an interesting account is given of the arrangements made. The output is 3000 tons a day, which it is intended to increase to 4000 tons. It was considered that, by the provision of anti-breaking devices in the skips and skip-measuring pockets, degradation would be reduced to a minimum and this has proved to be the case.

Planning for the Future

On August 26th an important paper was read by Mr. E. K. Brown, the mining engineer in charge of reconstruction and planning at the N.C.B., before the Coal Board's Summer School at Oxford. It goes further than the Board's Annual Report already referred to. As Mr. Brown stated, planning requires that the demand for coal now and in the future should be measured and that there should be a productive and development programme to satisfy the demand. But, as *The Times* put it in a leading article in its issue of August 27th, "There is one doubtful factor, however, for what remains in question is whether or not satisfactory means of measuring either demand or capital cost have yet been evolved, and these estimates are essential in deciding the economic efficiency of a plan."

Dealing with the question of cost, I alluded, in my comments, on the Board's Annual Report to "amortisation." Mr. Brown does not show on what basis either depreciation, amortisation, and interest charges are fixed. These may, he says, amount to 8s. a ton in some circumstances. As *The Times* remarks: "presumably this assumes a fixed and possibly a low rate of interest, but in circumstances such as the present, when many capital expenditures are being shelved or delayed, some means of finding which investments will yield the best return to the Nation is needed, low rates of interest cannot help in this—and the Board appears to have no other criterion."

The Board has not, it would appear, decided upon the precise form of its price policy; there may be "zone" prices, but Mr. Brown says "this will not conflict with the essential principle that the cost of fuel to the Nation is the cost of production plus the cost of delivery." But, as *The Times* rightly remarked, "The references in the paper to price policy are vague and though at first reading they sound well, they defy interpretation," and one is forced to agree with *The Times* that it is important "that the Board's proposals on price policy should be known and discussed, "for they could seriously distort industrial development."

Mr. Brown's paper is worthy of most careful study and should be read in conjunction with *The Times'* admirable leading article, according to which his paper "marks an advance in grappling with planning; it recognises impressively the need for suppleness, for constant adaptation to changing circumstances, and for dependence on local initiative. It does not, however, provide a means of gauging economic needs." With this criterion, impartially minded persons, versed in the coal industry, will be in entire accord.

Valuation of Colliery Interests for Compensation

The work for the allocation of the global sum of £164,660,000 among the twenty-one districts has proceeded throughout the year and the returns have all been sent in. There is little doubt that the total of the district valuations considerably exceeds the global figure and that most of the district figures, if not all, will suffer a reduction in the financial assessment. At the time of writing the composition of the district committees, whose work will lie in the checking of the separate colliery valuations, has not yet been published. It has been estimated that their labours will occupy perhaps five years as from the vesting date, before completion.

America and British Coal Mining: Mr. T. E. B. Young's Report

Mr. T. E. B. Young, Production member (in conjunction with Sir Charles Reid) of the National Coal Board, was commissioned by the Board to visit the United States to survey the latest and projected types of equipment and methods of deep and opencast mining. His report was issued on May 12th. His first duty, was, he felt, to find some technical solution to the home industry's problems which would bring about quick results. "I must confess," he writes, "that in this respect my mission was a failure. I am firmly convinced that the reason for failure is that no such solution exists. I believe there is only one quick solution, one immediate answer—more work; and I am convinced that the way to this lies in the provision of greater incentives." Among such incentives he suggested bigger rations and commodity dockets based on attendance. "Although a halt in further wage increases must surely now be called," he said, "every possible endeavour must be made to maintain the present wage level in the face of competitive world prices. This can only be done by increasing production"

But, as this interesting report has already been reviewed in its pages, readers of The Engineer will be versed in its contents, so there is no need to deal further with it in this article.

Reform of the N.C.B. and its Subsidiary Organisation

Rumour had been abroad during the early part of the past year that all was not well with the Board, that differences of opinion were rife among the members and credence was given to these rumours by a number of resignations which followed. Mr. Watson Smith, a mining engineer of experience and ability, resigned in January, stating "that he did so as a protest against the way nationalisation was being run. He found he was production director with responsibility and no power." He was production director of the East Midland Region and was one of the committee of which Sir Charles Reid was Chairman, which reported on the mining industry in March, 1945. About the same time Mr. J. E. Gridley, the marketing director of the N.C.B., also resigned. In March, Mr. F. Hunter, production director of the North East Division, resigned, his deputy, Mr. H. M. Hudspeth, D.S.O., a well-known and experienced mining engineer, having done so in January. Sir Charles Reid tendered his resignation of membership of the National Coal Board on May 13th. He, with Mr. T. E. B. Young, constituted the two mining engineers, or, production members of the Board. He stated: "I have resigned from the National Coal Board because I have no confidence in it or the organisation which it has set up": and he said also "without radical alteration from the Coal Board downwards the nationalisation of the mines will prove a disastrous failure."

The Minister of Fuel and Power appointed Sir Geoffrey Vickers, V.C., to fill the vacancy caused by the resignation of Sir Chares Reid. Sir Geoffrey was legal adviser to the N.C.B.

On June 23rd, the N.C.B. officially confirmed the resignation of General Sir Reade Godwin Austen, Chairman of the South Western Area Board. His resignation, he made clear, had nothing to do with that of Sir Charles Reid. Mr. J. B. Drinnan, General Manager of the South Derbyshire Area, East Midland Division also resigned,

The National Coal Board announced on October 20th that a committee on organisation under Sir Robert Burrows, a member of the Board, which had been appointed by the Board in May last to inquire into the Board's methods, had completed its enquiries. This committee, in addition to Sir Robert Burrows, included Sir Charles Renold, president of the British Institute of Management, and Sir Mark Hodgson, until his recent retirement, general secretary of the United Society of Boilermakers. The committee was set up at the time of the retirement of Sir Charles Reid from the Board, and it made investigations in the coalfields.

In the illuminating and trenchant articles entitled "The Problem of Coal," which Sir Charles Reid contributed to *The Times*, on November 22nd, 23rd and 24th, he con-

firmed what some informed critics of the N.C.B. had previously advanced, namely, that not only on the Board itself, but on the Area Boards also, few of the members had ever been in control of business—indeed, in regard to the institution of the National Board (set up in July, 1946) itself he said : "Most of those appointed had little or no experience of mining business at all, not to speak of a really large-scale enterprise. No plan, no blue print, no instructions whatever were given to the Board." Altogether, he painted a lamentable picture of bad and costly organisation. "Far too many of the London Board's decisions," he wrote, "have been the result of expediency rather than of principle." Again : "Some of the best mining engineers have felt compelled to leave the industry when they have had still years of good service to give . . . The value of the mining engineer has never been sufficiently appreciated by the National Coal Board itself." In such circumstances is it to be wondered that the coal industry is in such straits as we now find it ? "Instead of being alive and enterprising," writes Sir Charles, "it is in fact degenerating into a dull, mechanical form of civil service." There is, in his opinion, far too much centralisation, a feature to which attention has already been drawn in the pages of THE ENGINEER. Sir Charles' solution, which is much in accord with that propounded by Colonel Lancaster, M.P., in Parliament, in June last, and published in a pamphlet drawn up by him, lies in a scheme of separate or area corporations.

The Report of Sir Robert Burrow's Committee, which was published on November 22nd, whilst concerned largely with executive details, recommends that the Board should be enlarged by the addition of a second deputy chairman and up to three part-time members, and that there should be established four standing policy committees to lighten the work of the Board. They advocate devolution of responsibility as far as possible and a clear distinction between policy-making and execution. They also recommend that divisional chairmen should become members of the National Board, making a board of nineteen members in all. Whilst not suggesting that the Central Board should be stripped of executive powers, they do recommend that, as area management develops and grows stronger, the functions of divisional boards should become more and more those of co-ordination and advice and less and less those of executive management. This is largely in accord with an interesting article which Sir Robert contributed to the *Daily Telegraph* on March 25th—a thoughtful and wise article—entitled "Basic Defects in Organisation of the Nationalised Industries." Amongst other solutions, he suggested "The answer to the problems, I think, is a non-technical Board. This Board would supervise the operation of its industry and be answerable yearly or half-yearly to a committee of the House of Commons." and like other fair-minded critics, he drew attention to the defect of over-centralisation. Sir Charles Reid (and Colonel Lancaster, also) visualises District Corporations independent, in large measure, though not completely financially independent, from the Central Board. It is not clear, from what he writes, what is the extent of the financial control to be exercised over these corporations by the Central Board, and in the debate in the House of Commons on November 29th on the occasion of the second reading of the "Coal Industry Bill" (which amends the Nationalisation Act of 1946 and the Coal Mines Act of 1911) Mr. Gaitskell, the Minister of Fuel and Power, made a point on his lack of clarity in this respect. However, Sir Charles' views must command respect, coming as they do from a mining engineer of wide knowledge, experience and ability, and one who is a believer in the nationalisation of the coal mining industry.

THE COAL INDUSTRY BILL, 1948, PART I

The Government's proposals for reviewing matters in connection with the National Coal Board are contained in the Coal Industry Bill, (which by the time this article is in print, will have become an Act of Parliament), for Part I of this Bill relates to amendments of the Coal Industry Nationalisation Act, 1946. The Government does not, apparently, go to the full length of meeting the criticisms and suggestions put forward by the committee appointed by the Board itself, under the chairmanship of Sir Robert Burrows. It seeks to improve the organisation of the industry by some change in the composition of the Board, introducing part-time membership, leaving the number of full-time members to be decided at the Minister's direction up to a maximum of eight, and it allows of the appointment of a second deputy chairman. But the Bill does nothing about the subordinate structure, nor about decentralisation, which would, from the criticism almost universal, appear to constitute the gravamen of the situation !

The Board's powers are so extended that it may act outside the United Kingdom. That representatives may be sent out to supervise purchases of plant is all to the good, but as to the Board being qualified to set up its own selling agencies abroad to compete with private firms in the bunkering trade, to charter ships and sell direct to foreign buyers, *The Times* rightly said, in a leading Article, in its issue of November 30th, that the provision "invites criticism at the moment because the ability of the Board to conduct its affairs has yet to be proved, and there is almost universal agreement that the main deficiency lies in the failure to define and limit the functions which can properly and successfully be conducted at the centre. To add new tasks before the existing duties have been assimilated seems obviously imprudent."

THE COAL INDUSTRY BILL, 1948, PART II

By Part II of the Coal Industry Bill the Minister is given an extension of power to make General Regulations under the Coal Mines Act, 1911. The Royal Commission on Safety in Coal Mines, 1938, made a number of recommendations for raising the standard of qualifications of various classes of under-officials and for extending the statutory certificates system, which, when adopted, would lead to a considerable expansion of the functions of the Board for mining examinations, and necessitate a remodelling of that Board. Action on many of the recommendations of the Royal Commission, including those referred to above, has not been possible hitherto as they involve amendment of Part 1 of the Coal Mines Act, 1911, and there has been no power in the 1911 Act to do this, hence the present amending Bill. One awaits with interest information as to the precise nature of the general regulations proposed to be made by the Minister.

RESEARCH

Early in last July the Minister of Fuel and Power appointed a number of eminent scientists and technicians under the chairmanship of Sir Alfred Egerton, F.R.S., to act as a council on the scientific aspect of problems which he may present to them in connection with his statutory duty of securing the effective and co-ordinated development of coal and petroleum and other sources of fuel and power in Great Britain; and to keep the whole field of fuel and power under continuous review, "with the object of identifying problems needing scientific investigation and advising the Minister on these problems." This was a wise move and much good it is to be hoped will result from it.

CONCLUSION

If this record of the coal mining industry during the past year appears to readers a pessimistic recital, one can only say in extenuation, that the way to remedy a situation lies only in having and facing the facts of the case. No alleviation is to be found in the adoption of a Podsanpian attitude when faced by a disagreeable fact, of "I put it behind me." Whether we approve of a nationalised coal industry or not, it is our duty as patriotic citizens to do our best for the benefit of the nation; and seek to find the best way of amending matters. It seems obvious that the first thing to be done towards this end is to so arrange matters that decentralisation should, as far as practicable, be instituted in regard to the control of the mines : the duties of the Central or National Board should be those of laying down the broad lines of policy, leaving the general management of the collieries in the hands of those best qualified by technical knowledge and experience so to do. Absenteeism must be reduced to a prewar figure; the output per manshift must be increased, as it surely should be by reason of the enhanced mechanisation of recent years and, finally, the staffing of the collieries must be increased by at least 150,000 more workers. For, if we are to regain our erstwhile position in the coal trade of the world, we must attain to an annual production of 250,000,000 tons—in order to meet our home requirements and export 50,000,000 tons of coal.

Codes of Practice

The Codes of Practice Committee for Civil Engineering, Public Works and Building and Constructional Work is under the aegis of the Ministry of Works. Codes are issued on behalf of the Committee by the British Standards Institution, 24–28, Victoria Street, London, S.W.1.

WATER SUPPLY

Code 310. This code, now issued as a draft for comment, has been prepared by committees convened by the Institution of Water Engineers. The draft deals with the supply of water to houses, schools, hospitals and public buildings, and has been conveniently divided into five parts, viz., Public Supply, Private Supplies from Wells, Boreholes, Rivers, &c.; Conveyance; Storage, and Utilisation.

Although the code has been written with a view to giving a practical guide to the water engineer, pipe fitter and plumber, it has considerable interest for the general consumer.

Part I, Public Supply, deals with points of observance for those who are to be supplied from a public water undertaking. The parts dealing with Conveyance, Storage and Utilisation are applicable to both public and private supply. Part II makes a survey of the sources from which water is obtainable for private supply and contains advice and guidance on rendering the water suitable for drinking and domestic purposes.

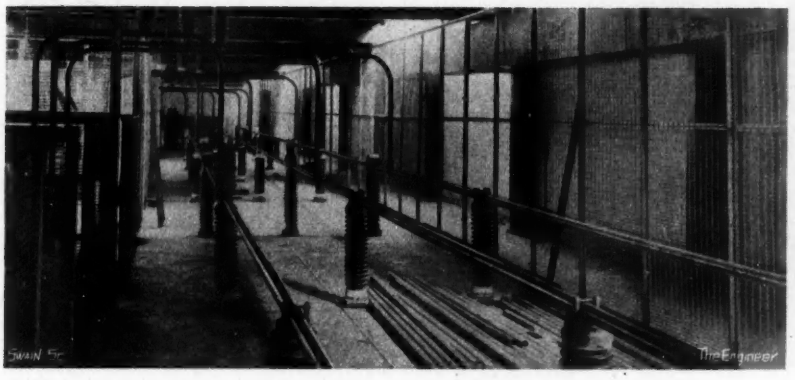
Part III is concerned with the conveyance of water from intake works to the place where it is used and with its distribution to individual points. Part IV deals with external storage of water and with internal storage cisterns, and Part V contains useful practical advice on fittings and appliances used at the draw-off stage and the arrangements necessary to ensure good working.

The Lists of British Standards, applicable to the materials, appliance and components, which are given, will prove of valuable assistance. The code is in draft form and subject to revision in the light of comments received, before publication in final form. Comments are invited and should be submitted by February 9, 1949. Price 6s., proof reference C.P. (B) 809.

Electrical Engineering in 1948

No. I

STATE ownership of the electricity supply industry, under the terms of the Electricity Act, 1947, became effective on "vesting day," April 1, 1948, when the British Electricity Authority, through its fourteen area boards and generating divisions, assumed responsibility for the general functions previously exercised by the Electricity Commissioners, the Central Electricity Board and the supply undertakings. To the ordinary consumer this momentous transfer took place so smoothly as to pass almost unnoticed, since his personal contacts with the supply industry remained unchanged, save only in name. With few exceptions throughout the industry the same day-to-day tasks continued to be performed by the same personnel and here we need not be concerned in detail with the administrative changes that did in fact occur.



STOURPORT "B." SWITCH ANNEXE, BUS BAR FLOOR

In general the administration is designed to achieve the maximum measure of decentralisation. The Central Authority is responsible for generating electricity and transmitting it to the Area Boards for distribution, via sub-areas and districts, to consumers. For convenience, the power stations in the country are grouped into fourteen generating divisions, which have the same geographical boundaries as the area boards, but exist as separate entities each of which, through its divisional controller, is responsible to the central authority for generating electricity. While the generating divisions are part of the organisation of the central authority, the area boards, which are responsible for distribution, are independent and autonomous bodies. They are subject only to the general guidance of the central authority, which is, of course, responsible for co-ordinating the work of the area boards and exercising general control over policy.

To allow for the expression of consumers' interests the Act of 1947 provides for the setting up of a consultative council in each of the fourteen areas. These consultative councils consist of twenty to thirty members appointed by the Minister of Fuel and Power. Although they have no specific executive duties they have direct access to the area boards to make representations on behalf of the consumers. The South Eastern Council was the first to be appointed, four other area councils followed soon afterwards, and it is expected that, by the time these words are read, all the remaining councils will be in existence.

Generating Capacity

The substantial assets acquired by the British Electricity Authority on vesting day were, unfortunately, accompanied by a number of liabilities and problems, including the necessity to authorise increased charges for electricity to present a balanced budget in the face of continued rising costs, many of which were inherited from the previous *régime*.

A more serious difficulty for which there is no satisfactory short-term solution is the shortage of generating capacity. This shortage, which is a direct outcome of the war, and is by no means peculiar to Great Britain, is being countered by the only means immediately available: first by load spreading and various restrictions on the use of electricity in industry, commerce and in the home, and, secondly, by increasing the generating capacity as rapidly as possible. Although the first of these expedients was intensified, with good effect, in 1948, the demand for electricity continued to grow, as indicated by the fact that 42,240,000 units were sent out from solid fuel-fired stations for public supply, an increase of about 9·6 per cent, compared with the corresponding output for 1947.

At the same time, plant extensions and new construction contributed to an increase in generating capacity of about 557MW, after making allowance for the removal of obsolete plant, &c. Unfortunately, the achievement fell substantially short of the programme for the installation of 1150MW of new plant. The deficit can no doubt be explained by shortage of labour, raw materials and productive capacity. It is disquieting, however, to observe, in passing, that the programme for plant installation has been falling into arrears for a number of years. Thus, taking an average for the ten years, 1935 to 1944, only 55·8 per cent of the plant programme* was actually achieved.

The main items contributing to the increased generating capacity during 1948 were the commissioning of boiler plant aggregating more than 5,500,000,000 lb per hour capacity, and the following turbo-alternator sets: four 30MW at Meaford, one 30MW at Newport, one 50MW at Neepsend, one 31·25MW at Bolton, one 30MW at Kirkstall (Leeds), one 30MW at Ocker Hill, one 53·5MW at Hams Hall "B," one 31·5MW at Ribble, and two 30MW at Kingston.

Power Stations

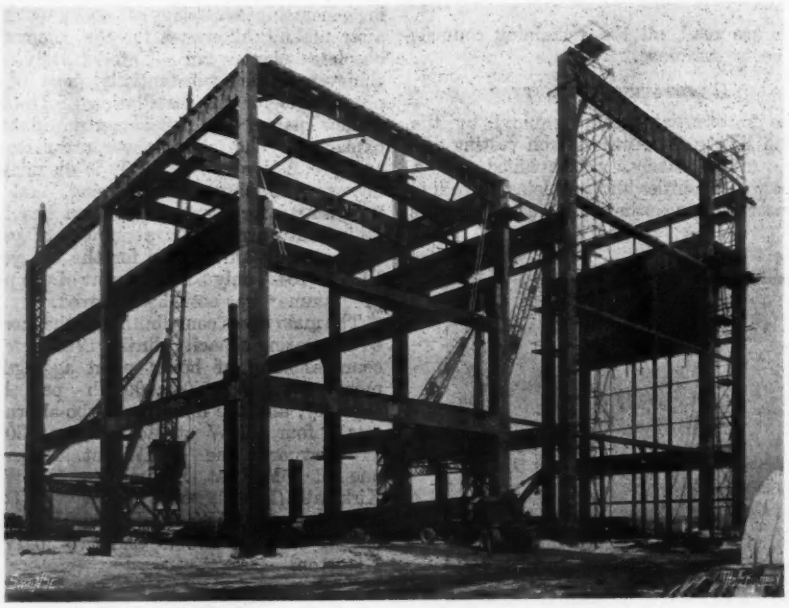
Meaford power station, which was fully described in THE ENGINEER, October 1–15, 1948, was officially opened by the Minister of Fuel and Power on October 20, 1947, and the four 30-MW G.E.C. turbo-alternator sets were brought into operation at intervals during 1948. A general view of the station is given in one of the accompanying Supplement pages. Steam is generated at 650 lb per square inch and 850 deg. Fah. in six Babcock and Wilcox boilers, with Bailey automatic control and pulverised fuel-firing. In the absence of river water, cooling is effected by two Davenport hyperbolic reinforced concrete cooling towers.

STOURPORT "B" POWER STATION DURING ERECTION

On October 27, 1948, H.M. The King performed the opening ceremony at Kingston power station and started up the first of four 30-MW B.T-H. turbo-alternators. A

* I.E.E. paper by A. R. Cooper, "Load Dispatching and the Reasons for it with Special Reference to the British Grid System." London, March 18th, 1948.

description of this installation appeared in THE ENGINEER, October 29 and November 5, 1948, and a view of the station from the River Thames is reproduced this week on one of our Supplement pages. In most respects Kingston power station is an orthodox post-war installation, based on stoker-fed Stirling three-drum boilers, with Hagan automatic control supplying steam at 600 lb per square inch and 825 deg. Fah. at the stop valve. With a view to preserving the local amenities, the station embodies a number of refinements, including electrostatic grit-precipitation and enclosure, as far as possible, of the coal and ash-handling plant.



POOLE. TURBINE AND BOILER HOUSE STEELWORK

LITTLEBROOK

In the following paragraphs brief reference is made to progress made in the construction of a few of the many power stations, which, it is hoped, should come into operation within the next few years.

Littlebrook power station (South Eastern Division), which was formerly owned by the Kent Electric Power Company, comprises one of the major developments in the country, since the ultimate capacity envisaged on this site is 960MW. The first half of the scheme consists of stations "A," "B," and "C," of which station "A" has been in operation for a number of years, while stations "B" and "C" are still under construction.

Station "A," which is complete, houses two 30-MW and one 60-MW turbo-alternator sets, taking steam at 600 lb per square inch and 800 deg. Fah. from six 256,000 lb per hour boilers, three being chain-grate and three pulverised fuel fired. The turbo alternators and the boiler plant are arranged parallel to each other.

Station "B," which is at present under construction, is designed for steam conditions of 1235 lb per square inch at 825 deg. Fah., and will consist of two 60-MW Metropolitan Vickers hydrogen-cooled turbo-alternators, and four 265,000 lb per hour International Combustion, reheat, pulverised fuel-fired boilers, arranged in line. The first half of this station (No. 4 set) is planned for commissioning this month; the second half is ready to receive the boilers and is due for commissioning by March, 1950.

Station "C" is a later development, for which excavations are now taking place. The steam conditions will be 900 lb per square inch and 900 deg. Fah. and the generating plant will consist of four 60-MW hydrogen-cooled turbo-alternator sets, together with eight pulverised fuel-fired boilers.

The consulting engineers for the Littlebrook scheme are Messrs. Merz and McLellan, and, on the civil engineering side, Sir Alexander Gibb and Partners.

STOURPORT

Another interesting station incorporating high-pressure steam plant and hydrogen-cooled alternators is Stourport "B" station (Midlands Division), which formerly belonged to the Shropshire, Worcestershire and Staffordshire Electric Power Company. Stourport "B" station is being built in two parts, the first part consisting of a 60 MW English Electric hydrogen-cooled turbo-alternator and a 525,000 lb per hour pulverised fuel-fired Stirling boiler. The boiler and turbo-alternator form a self-contained unit without any interconnection with other units and there will be no dividing wall between boiler-house and turbine room. The steam conditions are 1250 lb per square inch and 950 deg. Fah.

Construction of this part of the station is well advanced; the condenser is in position and tubed; the turbo-alternator and many of the auxiliaries are installed and being interconnected; the boiler drums are in position, with the economiser headers and air heaters installed and connected up. The coal-handling plant is complete and it is hoped that the first part of the station will be ready for commissioning by the end of this year.

Higher steam conditions—1500 lb per square inch and 1050 deg. Fah.—will be adopted for the second part of the station, which is due to be commissioned in 1952, Here again the plant will be arranged on the unit system with one 515,000 lb per hour boiler supplying one 60-MW turbo-alternator.

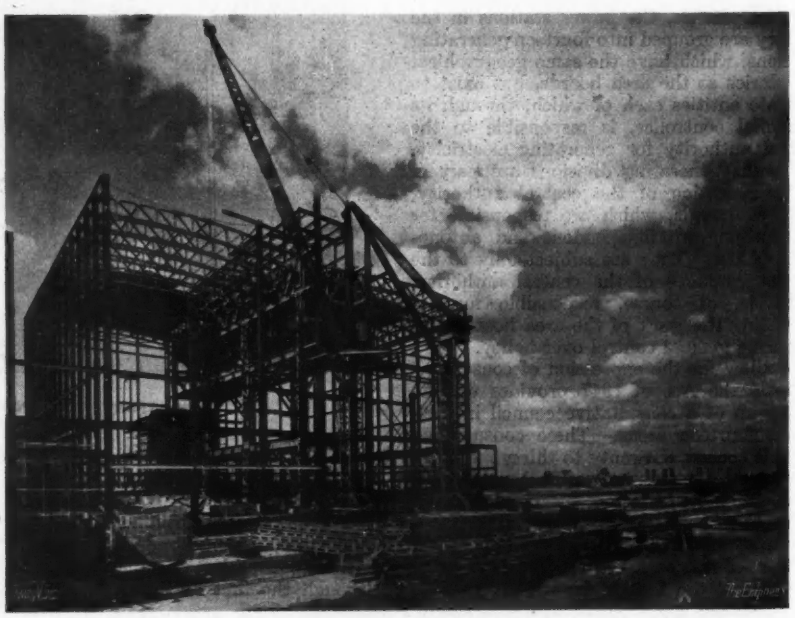
An interesting detail in this station will be the circulation of warm air to prevent condensation in the switchgear annexe, making use of surplus heat from the separate motor-driven exciter. It is proposed to install a heat pump in the office block and stores, using the waste heat in the circulating water.

The consulting engineers for this station are Messrs. Ewbank and Partners.

STAYTHORPE

Staythorpe power station (East Midlands Division) was originally developed, on a virgin site, by the Derbyshire and Nottinghamshire Electric Power Company. The station is designed for an ultimate capacity of 360MW and will be built in three sections, each comprising two 60 MW air-cooled B.T.-H. turbo-alternators and six 240,000 lb per hour spreader-stoker-fired Babcock and Wilcox boilers. The steam conditions will be 900 lb per square inch and 900 deg. Fah. While the sets will be arranged in line, the boiler-house associated with each section will be disposed at right angles to the turbine-house and will have a central aisle flanked on either side by three boilers. No cooling towers are installed, the circulating water being taken from the River Trent.

Two photographs are reproduced herewith



STAYTHORPE. STEELWORK FOR BOILER HOUSE AND TURBINE ROOM

to show the progress made on site. The first illustration shows the state of the steelwork for the boiler-house and turbine room during the early part of the year. Some six months' progress is indicated in the second illustration, which gives an inside view of the boiler-house (west side), showing the chimney and part of the steelwork for boilers Nos. 3 and 5.

The consulting engineers for this scheme are Balfour Beatty and Co. Ltd. It is planned to commission the first section of the station by September, 1950.

Croydon "B"

Croydon power station (South Eastern Division) was formerly owned by the County Borough of Croydon Electricity Department. The "B" station is sited some 1½ miles, as the crow flies, from the existing "A" station. Provision is made at "B" station for an ultimate capacity of 315MW, made up of six 52·5-MW turbo-alternator units, designed for steam conditions of 600 lb per square inch and 850 deg. Fah. When completed this station will have twelve 320,000 lb per hour boilers, arranged in line and parallel to the turbine-house.

The scheme is being carried out in four sections, the first of which will comprise two Metropolitan Vickers' turbo-alternators with four pulverised fuel-fired 320,000 lb per hour Simon Carves boilers. Three cooling towers, each with a capacity of 2,500,000 g.p.h., will handle the circulating water for these sets. The first section of this station is scheduled for commissioning during 1950. The structural steelwork for the first two boiler bays and corresponding part of the turbine room is well advanced, and the two brick-built chimneys are nearly complete. Some six months' erection work has been done on No. 1 boiler, for which the drums are in position and the tubing has been started. The main switch-house is complete and good progress has been made with the erection of the 33-kV Reyrolle switchgear.

A third turbo-alternator with two boilers and two cooling towers will make up the second section of the station, which is also due to be commissioned in 1950. The third section, which is planned to be in service during 1951, will comprise a fourth turbo-alternator with two boilers and one cooling tower. Approval has not yet been granted for the fourth section, consisting of two turbo-alternators, four boilers and three cooling towers, which will complete the development.

Poole

Poole power station (Southern Division) was originally planned by the Bournemouth and Poole Electric Supply Company. A brief reference to the constructional work was made in the corresponding review article approximately a year ago, and one of the accompanying illustrations shows the progress made with the erection of the structural steel work by the autumn of last year. It is hoped to commission the first turbo-alternator with its two boilers by the end of 1950.

The station, which has access to sea water for condenser circulation, is designed for an ultimate capacity of 200MW with an installation of four 50 MW turbo-alternator sets. The first of these sets will comprise a 50-MW air-cooled Metropolitan Vickers turbo-alternator and two 300,000 lb per hour International Combustion boilers, having steam conditions of 900 lb per square inch and 925 deg. Fah.

Erection of the three remaining sets, with the associated boiler plant and auxiliary equipment, will proceed in sequence, with a view to commissioning the whole station by 1952.

The consulting engineers are Messrs. Merz and McLellan for the project as a whole and Messrs. Mott Hay and Anderson for the civil engineering work.

Battersea "B"

In this article we can refer to one only of the many power station extensions now in hand.

Battersea power station (London Division), which was originally owned and operated by the London Power Company, consists of two turbine-houses, "A" and "B," with a common boiler-house.

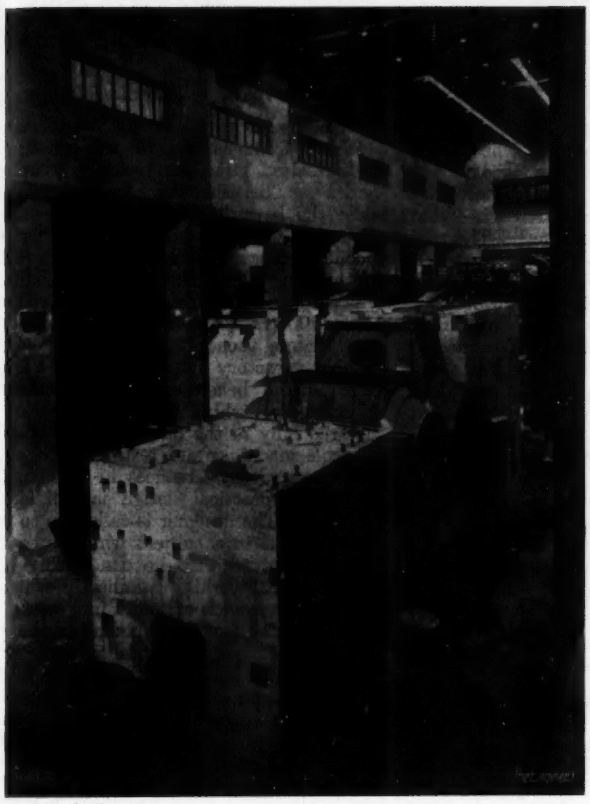
Battersea "A" station, completed in 1936, houses two 69-MW and one 105-MW Metropolitan Vickers turbo-alternators, arranged in tandem. Steam is generated in six 312,000 lb per hour boilers and three 375,000 lb per hour boilers, all of which are retort stoker fired, and were manufactured by Babcock and Wilcox, Ltd., for steam conditions of 600 lb per square inch at 850 deg. Fah.

Battersea "B" station had an initial capacity of one 100-MW turbo-alternator, taking steam from two 550,000 lb per hour retort-stoker-fired boilers. An extension which is now in hand will provide one 60-MW hydrogen-cooled turbo-alternator and three 400,000 lb per hour pulverised fuel-fired Babcock and Wilcox boilers, designed to operate with steam conditions of 1350 lb per square inch at 950 deg. Fah.

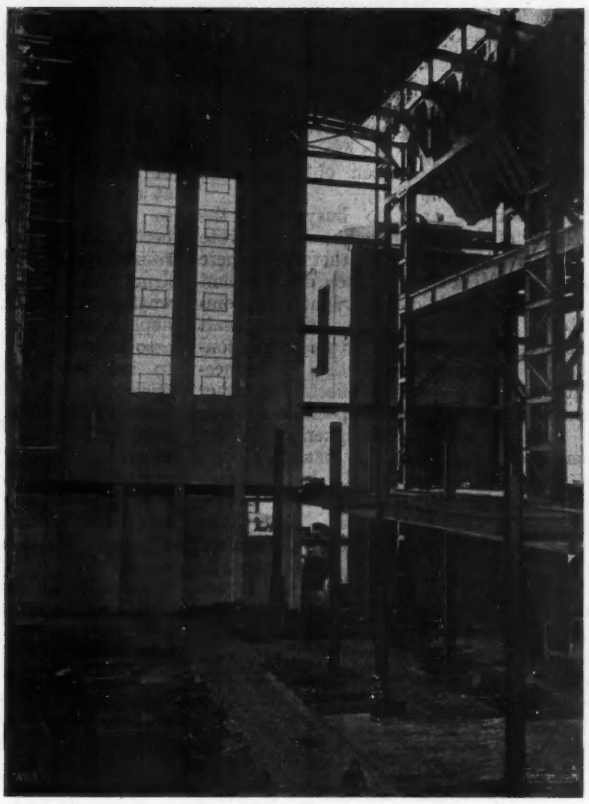
Some indication of the progress made with this extension is given in one of the accompanying illustrations, which shows the turbine block for No. 5 set, with the condensers in position. The new plant is due to be in service by June, 1951.

At some later date an additional 100-MW set and three 400,000 lb per hour boilers will be provided to complete the station.

(To be continued)



BATTERSEA "B". TURBINE BLOCK NO. 5 SET



STAYTHORPE. INSIDE OF BOILER HOUSE

Critical Review of Gas Turbine Progress

No. I

(Contributed)

General Position

GAS turbine technology is characterised at present by an apparent lull; little new information is coming forward, few new ideas, and few new orders are being placed. This is probably a natural recoil. The sales propaganda of a few years ago, designed to sell turbines or licences, having achieved its object, has now been called off, either to give the designers time to deal with the heavy task they have taken on, or because no more orders are desired until some experience has been obtained with machines already built.

Manufacturers are too busy with the problems of building machines to devote time to writing papers on them and there is a growing tendency to keep development secret for fear publication might help competitors. There is also a disposition to await the success of trial plants at present in construction before making further pronouncements, an attitude which reflects the rather tentative and experimental position of even the most experienced designers. In the absence of propaganda by manufacturers the gap has been filled by research workers, who as a class are fundamentally more optimistic than the practical designer. The outlook required for research is completely different. The vision must be focused on the far future and present practical difficulties may be brushed aside, on the assumption that they may also be overcome by further research. There is indeed often an impatient inclination to consider that if the invention does not fit into the existing background then the background should be altered. The proportion of projects which produce results is low, and the length of time required for development is so long as to call for sustained optimism which tends to preclude the forming of a balanced judgment, and to the manufacturer seems out of place either in assessing the present position or in prognosticating for the future. Engineers in general will desire a more dispassionate approach involving a full knowledge of a wide background and of the capabilities and defects of other plant, including information on costs, which the research worker does not necessarily acquire in his close application to involved detail.

The competitive position of the gas turbine in relation to other plant cannot be summarised in a few words. The machine permits of multifarious variations and assumes widely different forms with quite special characteristics according to the application and the nature of the drive. It is a misfortune that the whole gamut from the jet-propelled aircraft unit to a highly complicated, efficient, but heavy multiple shaft land machine is covered by the same name. The effect is to impart to staid land designs and applications some of the glamour which attaches to the aircraft application. It causes confusion in lay circles and even among those intimately connected with the subject. The publicity which surrounded the initial announcements regarding jet-propulsion created a dramatic effect and made a great impression on the general public, an effect to which directors of engineering firms were not immune. Although jet propulsion made no impact on the war, never having been used operationally by the Allies over enemy country, the rapidity of its development and the decisiveness of its advantages in the high-speed fighter application over existing reciprocating engines with forty years of refinement behind them, was nevertheless startling. Small wonder that directors of firms interested in diesel engines, steam turbines or boilers should have concluded that the gas turbine would sweep these other fields, and that they must at once do some research or else risk being left behind. The freeing of research expenditure from income tax at about the same time made it necessary to find something to research on—what better than the gas turbine? The net result is that there is a risk of some ten firms reduplicating each others' work, with wastage of national effort which would be deplorable. In these days of trade associations one might have expected to see the work concentrated in a co-operative research establishment so that each mistake need have been made but once instead of by ten organisations separately. A careful survey of likely developments and an investigation of the past history of the gas turbine would have counselled caution, and it may well be that the wisest in the long run will prove to be those who decided to "wait and see" in the confidence that they can enter into a licence arrangement at a later date if necessary.

Licence Arrangements

Licence arrangements from more experienced firms, particularly in Switzerland, might have been a saving to the British industry not only in time but also in expense. The belief that such licence arrangements are unnecessary and possibly beneath national dignity can be held only by those who do not distinguish between aircraft and land types, or between the undigested theoretical knowledge produced by research and the practical "know-how" employed by the manufacturer. The leading position held by the Swiss is not entirely attributable to their not having been occupied by war-work. The foundations of their developments were laid considerably before the war and, incidentally, must have contributed quite a considerable, though unacknowledged, part to our wartime development of aircraft types. The war it is true gave the Swiss time to develop their ideas without competition but, on the other hand, produced a stimulus and urgency in this country which set a pace far in excess of peacetime conditions.

The Swiss, not being interested in aircraft, have concentrated on land and marine types. Their individuality and absence of co-operative or central research has led to the different firms pursuing independent and competitive lines, so that each of the four has evolved some speciality of its own. Their development of such plant is still several years in advance of ours.

Development in the U.S.A. shows the benefit of one firm having worked under Swiss licence before the war and another later under Swedish licence. Development work was carried on under Government stimulus, particularly on marine applications, and though this had no influence on the war it is now bearing fruit. Several firms have run full-scale prototypes for many months in workshop tests, and on the basis of this experience they can now offer commercial machines subject to ordinary guarantees. A 3500 h.p. gas turbine locomotive has been completed and is undergoing trials on the rails. Several others are not far behind. A gas turbine ship is also near completion. One land machine is being tried out in commercial operation, while several others are on order. All of the sets built or ordered are of simple type, with rather moderate efficiencies, but having already been proved in test running can be regarded as in some respects a stage ahead of British designs.

Performance of British Machines

It is no secret that the performances obtained from several of the smaller or medium-sized machines recently completed by different British makers are disappointing, while the long delays in completing some others must be attributed to difficulties encountered or inability to finalise the design, rather than material shortages. The building of satisfactory gas turbines for industrial purposes involves far more than merely some aerodynamic theory and the possession of suitable refractory materials. Precise knowledge of the behaviour of components is also essential, which unfortunately can be acquired only in the hard way, by building full-scale machines and testing them, since, for all the recent advances in aerodynamic knowledge, practical design is still largely empirical. The designer is called on to take unusual risks in a subject which is so new and so involved that he can hardly have acquired that working familiarity which is necessary as a basis of sound judgment.

The penalty for misjudgment in the performance of components is far greater in the gas turbine than any other known engine, if only because as much as three-quarters of the gross output is consumed internally. Materials are worked at temperatures far in excess of experience in any other field, and alloys have to be put into use before any long-period data on their behaviour under test is acquired. Further, in no other case is there such a risk of failure as occurs in the problem of matching the turbine and compressor characteristics. It is true that this is avoidable by the use of a centrifugal or a constant displacement compressor, but these entail a serious sacrifice of prospective efficiency.

Disappointments and setbacks are accordingly to be expected in the first machines made by any concern taking up the business *de novo* or even in developing from small-scale pilot plant to full scale. It may indeed be necessary to construct several machines before the designer acquires sufficient information to be sure of his ground. When he has acquired this technical information it will then be necessary to take into account the cost of production. It is common knowledge that components for gas turbines are proving very costly, not only for the special materials but also because of the intricate and accurate machining required. Even to experienced steam turbine builders many features are novel, apart from the axial compressor, e.g., the necessity for working with large forgings in highly refractory alloys, which practically forces him to adopt welded construction. Until one or two machines have been built a manufacturer can make no close estimate of the likely cost of subsequent machines. It is generally assumed that manufacturing costs will be considerably reduced when the technique becomes more familiar, but this depends on whether some of the refinement thought

necessary at present can be dispensed with. Pending the establishment of a firm basis of cost or price, the probable fields of application of the gas turbine, based on its ability to compete commercially with other plant, remains a matter for speculation.

Application of Aircraft Technique

One way of reducing cost of manufacture is to use less material, and in certain cases where the speed can be chosen at a suitably high value the gas turbine lends itself very markedly to reduction of weight by the adoption of aircraft technique. For example, the 2500 h.p. modified aircraft unit in the "M.G.B. 2009" weighs 3½ tons, including gears, while a 2000 h.p. locomotive unit built recently in the U.S.A., showing less aircraft influence, weighs 17½ tons. At the other extreme the 4000-kW Neuchatel set, based entirely on land practice, must weigh nearly 100 tons. On the other hand, saving in weight so far entails severe sacrifice of efficiency and this is not fully counteracted even by employing very high temperatures, as is shown by recent locomotive units in the U.S.A., employing initial temperatures of the order of 1470 deg. Fah., attaining no better efficiency than the Neuchatel unit, with its temperature of 1022 deg. Fah., while the M.G.B. unit, more definitely an aircraft type, was even lower. Saving in weight *per se* is vitally important in aircraft and of some account in ships. It may be questioned how far it is worth reducing the weight of a locomotive gas turbine when the weight of the whole locomotive is 223 tons, as in a recently built example in the U.S.A.

The direct transfer of ideas based on aircraft technique to land or marine work will lead to absurdities; the basic economics of the two fields is so widely different. In the air, the saving of one ounce of weight has been valued at five dollars. On land, for base load service, and at sea, in the merchant navy, weight is of secondary importance compared with the fuel bill. The old rule still applies that if a steam turbine is 10 per cent worse than guarantee it should be thrown away and replaced by a proper one. This is based on coal at 50s. per ton, and, say, 6600 running hours per annum, in which the turbine consumes the heat equivalent of £7 10s. worth of coal per kilowatt. This is roughly the capital cost of the machine. In the case of the gas turbine the relation requires modification to fit the higher cost of oil and the fact that the equivalent of the boiler is included, thus, at sea, with oil at £6 10s. per ton and 5000 running hours, the annual fuel bill, based on an efficiency of 30 per cent is £6 8s. per horsepower. Hence, the penalty of falling below guarantee is higher but is a lesser fraction of the probable plant cost. On land, in applications where competition with coal is to be considered, the higher price of oil (about double that of coal on a thermal basis) limits the economic utilisation with the result that efficiency does not carry so high a premium.

Running Experience

The whole gas turbine industry, involving some 200,000kW of generating plant under construction throughout the world, as well as a large number of experimental and other machines, is somewhat precariously founded on a few thousand hours' running of a handful of small pioneer sets. There is, it is true, background knowledge of a related character. Thus, the cumulative running hours with aircraft units must be quite considerable, but the machines bear only a somewhat distant resemblance to land forms. Similarly, the very extended running experience over thirteen to fifteen years on Velox and Houdry sets relates to small machines, run normally at substantially lower temperatures. Much the same is true of the locomotive, since in its running of some 112,000 miles the mean load must have been far below full output. The 4000-kW Neuchatel set, with about 400 service hours, the locomotive and the 13,000-kW Beznau No. 1 with about 1800 hours are the only machines to have done any commercial running outside the manufacturers' own establishment. Among test machines which have had extensive running are the Escher Wyss 2000 kW set, which has run 3500 hours, the 1000 kW Oerlikon set, with 4000 hours, and the 500 h.p. Parsons set, with 1500 hours.

Fouling of Compressor and Turbine

In the course of test running two troubles outside the control of the designer have been encountered in open-circuit machines. These are the fouling of the compressor with oil and dirt drawn in from the atmosphere in industrial districts, and the fouling of the turbine blades by slag formed from the ash in lower-priced oils.

Compressor fouling has been encountered in this country with small machines of two makes, and in one aircraft type plant in the U.S.A. It was reported to cause rapid falling-off of compressor performance. This trouble has not, however, been met in Switzerland or with Swiss designed machines in industrial atmospheres in oil refineries, boiler-houses, or in the locomotive, hence it appears that the trouble may be related to the design of the compressor. British makers are requiring the air to be filtered at the intake to the compressor, but whether the filters themselves will be the source of trouble remains to be seen.

The second trouble has also occurred in one British machine and was traced to the presence in the oil of vanadium pentoxide, in association with sodium compounds. These are contained in the ash in some crude oils and are vaporised in the combustion chamber and recondensed on the turbine blades as slag. This trouble has apparently not been encountered in foreign designs, a fact which was at first attributed to their use of lighter oils. However, a sample of a difficult oil was recently tried in a Swiss turbine and was reported to create no difficulty, hence it is not known whether the trouble is related to the design of the combustion chamber, including the presence or absence of a refractory lining, or to the design of the turbine blades. For the present, British firms are inclined to avoid the issue by specifying the use of distillate oil, which does not contain ash but is about 20 per cent dearer.

Swiss designers whose sets account for over 60 per cent of the plant so far ordered throughout the world, do not appear to take either of these troubles seriously. In the closed-circuit machine they are, of course, avoided or transferred elsewhere. In the semi-closed a part of the plant also uses clean air, but a large fraction of total plant ordered in Switzerland and in the U.S.A. is of the open-circuit type, in which the troubles might be expected to occur if they are inherent.

(To be continued)

Naval Construction in 1948

By FRANCIS McMURTRIE, A.I.N.A.

No. II—*(Continued from page 12, January 7th)*

United States Navy

THE biggest warship ever built was ordered last year from the Newport News Company's yard. This is an aircraft carrier of 65,000 tons standard displacement, designed to operate twenty-four four-engined 50-ton bombers, with an operational range of 1700 miles. Her length over all will be 1090ft, the waterline figure being 1030ft. The beam across the flight deck, 190ft, will be capable of increase to 236ft by means of retractable extensions. Propulsion will be by geared turbines of about 280,000 s.h.p., expected to be equal to a speed of 33 knots. Annexed is an official sketch which will give some idea of the probable appearance of this enormous ship, the cost of which is expected to be at least $125,000,000.

There is still one ship of the numerous "Essex" class to be delivered. This is the "Oriskany," laid down in May, 1944; modifications in design are understood to have been responsible for the delay. When finished she will be able to operate larger aircraft than her sister ships. Lifts will be of greater size accordingly, catapults more powerful, and the flight deck stronger. Increased stowage for petrol is to be provided. Other ships of the class are likely to be modified on similar lines. Two units of the "Independence" class are to undergo alterations, to enable them to specialise in anti-submarine work.

Though work was resumed last August on the battleship "Kentucky," it is thought that this is merely in order to free the dry dock in which she is being built. Nothing further had been done in regard to the battle-cruiser "Hawaii," and it is questionable if she will ever be completed, at any rate to the original design.

Towards the end of last year the heavy cruiser "Des Moines," name-ship of a class of three, was commissioned. Of 17,000 tons standard displacement, she is an expansion of the "Oregon City" design, with the same general characteristics, apart from her armament. This comprises nine 8in, twelve 5in, forty 3in, and twelve 20mm guns, all of which are fully automatic. Cartridge cases have replaced wrapped charges, and shells have an automatic fuse setting. The 55-calibre 8in guns are said to be capable of firing four times as rapidly as any previous model. Rapid loading gear and extra magazine space are understood to account for much of the 3300 tons extra displacement, as compared with the "Oregon City," though some saving was effected by a reduction in complement.

What was to have been the fourth ship of the "Oregon City" class, the "Northampton," has been completely redesigned for duty as a Task Force Command ship, involving extensive alterations in accommodation and equipment. It is expected that her main armament will consist of 5in guns.

Of the light cruisers "Worcester" and "Roanoke," of 14,700 tons, the former went into service last year, and the latter will soon follow. Unlike the "Fargo" class, they have two funnels, and their

armament varies. It includes twelve 6in, twelve 3in, and sixty-six 40mm guns; the 6in are of a new automatic model, and the 3in are in twin mounts of a modified type.

A special anti-submarine ship, ordered in 1947 from the New York Shipbuilding Corporation, has proved to be a cruiser of 5500 tons or more, with a hull form resembling that of the fast "San Diego" class. The cost of this vessel and of a sister ship put in hand last year at Philadelphia Naval Shipyard will approach $40,000,000 each.

Four destroyers of a new and powerful design, expected to displace well over 2500 tons, are to be named "John S. McCain," "Mitscher," "Wilkinson" and "Willis A. Lee," in honour of flag officers, since deceased, who distinguished themselves during the late war. Two of these destroyers are being built by the Bath Iron Works Corporation and two by the Bethlehem Steel Company, Quincy.

There are nine submarines under construction. Six are of a new high-speed type, said to be engined with hydrogen-peroxide motors; the displacement of these will be about 2000 tons. The remaining three are of a special design, intended for operation against enemy submarines; no details of these have so far been released. One each is to be built by Mare Island Naval Shipyard, the Electric Boat Company, and the New York Shipbuilding Corporation. The Electric Boat Company have also in hand three of the fast type, two of which are to be named "Trout" and "Trigger." Portsmouth Naval Shipyard are to build the other three, for two of which the names "Tang" and "Wahoo" have been selected.

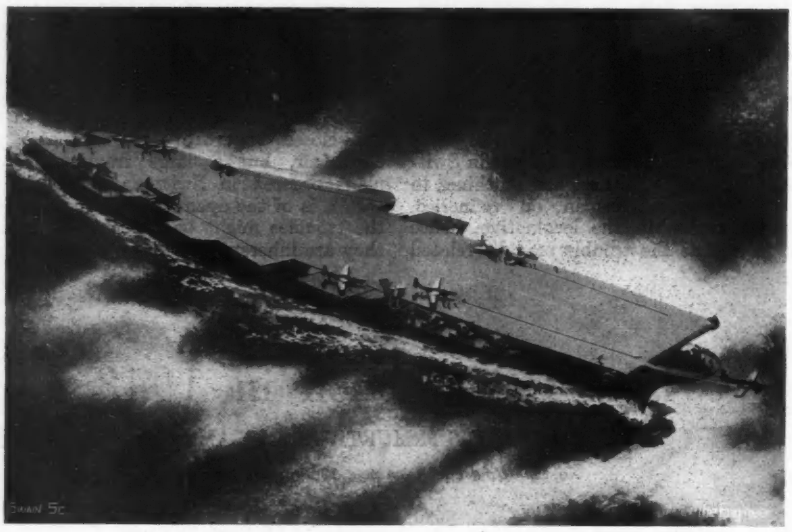
Four motor torpedo boats of experimental design, "P.T.C. 809–812," were delivered last year, though no particulars have yet been published concerning them.

There is a long list of ships, complete or incomplete, which are being reconstructed to modified plans, the total exceeding thirty, as far as can be ascertained. Two carriers of the "Essex" class and two of the "Commencement Bay" class are being modernised; a dozen destroyers of 2100 tons are being adapted for escort duties; two destroyer-escorts are being equipped for radar picket service; six destroyers of 2200 tons are being rearmed for anti-submarine work; six submarines are being fitted out for various specialist duties, including cargo and troop-carrying, polar picket service, and fuelling, and a cargo ship and two landing ships (dock) are being refitted for service in high latitudes.

Minor modifications were recently completed in the seaplane tender "Norton Sound," to enable her to undertake experiments with guided missiles. Her two forward 5in guns have been removed to make space for a helicopter platform.

Italy

No important changes have taken place in the Italian Navy, other than the transfer of the battleship "Giulio Cesare," the cruiser "Emanuele Filiberto Duc d'Aosta," six destroyers, two submarines and some smaller craft to Russia; of the cruisers "Attilio Regolo" and "Scipione Africano," a sloop, four destroyers and some minor units to France; of the cruiser "Eugenio di Savoia" to Greece; and of various small vessels to Yugoslavia. The battleships "Italia" and "Vittorio Veneto" are in the hands of the shipbreakers. Nine tugs—probably ex German—have been purchased from the United States.



U.S. Navy's 65,000-Ton Aircraft Carrier

Russia

With the acquisition of the Italian ships mentioned above, the Soviet Navy is returning to Britain the battleship "Royal Sovereign," seven old destroyers and three "U" class submarines. At the same time there are due for return to the United States the cruiser "Milwaukee," twenty-eight frigates, three icebreakers and a great many smaller craft.

Contradictory reports surround the fate of the ex-German ships, "Graf Zeppelin," "Lützow," "Seydlitz," and "Schleswig-Holstein," all of which were refloated and towed to Russian Baltic ports. According to unofficial accounts, these ships are being refitted for service, but it has also been stated that they have been dismantled and scrapped.

Two cruisers of the improved "Kirov" type, named "Kaganovich" and "Kalinin," built at the Komsomolsk shipyard on the Amur, have been completed and are in service in the Far East. Four more ships of this class are said to be under construction, but it is uncertain how much progress has been made with them.

Destroyers are being built with a fair amount of regularity, but the chief shipbuilding effort is being concentrated on submarines. It is hoped to have 1000 of these in service by 1951, though whether the materials for such a huge programme will be forthcoming remains to be seen. At present the total available is believed to exceed 250.

Minor European Navies

Both the Swedish destroyers of the "Oland" class are now in service. Their main armament comprises only four 4·7in guns, not eight as at first reported. Two more of this type are to be built. Ten motor torpedo boats are under construction, together with a 2000-ton icebreaker of similar type to the "Atle."

Owing to difficulties in obtaining materials, progress with the various ships under construction for the Spanish Navy is still very slow. No further launches have been reported. Six submarines of 760 tons have been ordered.

The Royal Netherlands Navy has been strengthened by the acquisition from this country of the light fleet carrier "Venerable," since renamed "Karel Doorman," the submarines "Tapir" and "Taurus," and the landing ship "Thruster," the three latter now bearing the names "Zeehond," "Dolfijn," and "Pelikaan" respectively.

In March last six destroyers, designed for anti-submarine duties, were ordered by the Netherlands Government, three from the Schelde yard and one each from the Wilton-Fijenoord concern, the Rotterdam Dry Dock Company and the Nederland Shipbuilding Company. Three surveying vessels are also being built.

Turkey has acquired from the United States four submarines and three auxiliaries. The former have been renamed "Birinci Inönu," "Ikinci Inönu," "Gür," and "Sakarya," the older submarines, which previously bore these names being given numbers instead.

Greece has received the cruiser "Eugenio di Savoia" from Italy, and has purchased three fleet minesweepers from the United States. Denmark has acquired two ex German torpedo boats of 800 tons, and has completed all but two of the six smaller torpedo boats built in the Royal Dockyard at Copenhagen. The wooden vessel, "Vitus Bering," ex "Restorer," has been purchased from the United States for fishery protection service in Greenland waters.

Reconstruction of the five Portuguese destroyers of the "Vouga" class by Messrs. Yarrow is proceeding satisfactorily, the "Douro" having been completed and delivered. Three British submarines of the "S" class have been purchased, the "Narval" (ex "Spur"), "Nautilo" (ex "Saga"), and "Neptuno" (ex "Spearhead"), together with the sloops "Avon" and "Awe."

Far East

Siam has bought two corvettes, formerly in the Royal Indian Navy, and two minesweepers. Japan has been given permission to maintain a fleet of 125 vessels, none to exceed 1500 tons in displacement or to have a speed of above 15 knots, the total tonnage being limited to 50,000.

Latin-American Republics

No effect has yet been given to the proposal to present two U.S. cruisers to Brazil, one to Chile, and one to Peru, Congress having failed to ratify it. For the time being therefore it must be regarded as dormant. Instead, Chile has been negotiating

for the purchase of H.M.S. "Ajax," of River Plate fame; Brazil has acquired three oilers, three tugs, and a sail training ship; and Peru has added three frigates, two motor minesweepers, and four landing craft to her fleet.

Cuba has acquired three frigates, seven patrol vessels, and two tugs; Mexico has bought four frigates, while the Dominican Republic, busiest of all, has raised its total strength by various acquisitions to two destroyers, four frigates, five corvettes, three patrol vessels, and over twenty minor war vessels.

International Conference of Engineering Societies

In our issue of October 15, 1948, we referred briefly to the fact that an international conference of engineering societies had just been held in this country. More particulars of this conference have now become available. The three covering institutions in this country were the Institutions of Civil, Mechanical and Electrical Engineers, and visiting delegates came from Société Royale Belge des Ingenieurs et des Industriels, Dansk Ingeniorforeningen, Société des Ingenieurs Civils de France, Koninklijk Instituut van Ingenieurs, Den Norske Ingeniorforening, Svenska Teknologforengingen, Schweizerischer Ingenieur und Architekten-Verein, Engineers Joint Council, U.S.A. The Conference took place from October 4th to October 8th, in London. The following account of the proceedings at the Conference is abstracted from the *Journal* of the Institution of Mechanical Engineers.

At the preliminary meeting which was held on October 4th, the delegates from overseas were welcomed, and the Conference then agreed on the manner in which its business would be conducted. A detailed summary, which had been prepared in advance, was then studied, in which the aims, objects and activities of the participating societies were set out. An opportunity was taken by question and answer to clear any points of uncertainty as they arose.

At their second meeting, the Conference discussed how technical information could best be disseminated, and considered means whereby interchanges of authors and lecturers between societies in different countries could be facilitated. The means by which the societies kept their members informed of technical progress were discussed, and the work of various abstracting services operating in the engineering field was reviewed, as were the practices of the participating societies in publishing items of interest concerning their activities to the general public. This meeting of the Conference also reviewed the existing arrangements in regard to visiting members of sister Institutions, and drew up plans for a greater measure of uniformity in this regard. Another matter of considerable interest was dealt with, that of the arrangements under which an Institution constituted in one country undertakes local activities in the territory of another having its own national engineering Institution.

The fourth and final meeting was held on October 8th, when the Conference considered the nomenclature and requirements for the various grades of membership of the participating societies and the international relationships of engineering societies, paying particular attention to the relative merits of conferences of this character, and of the activities of other international organisations which operate with a much more rigid framework, such as the "Conference Technique Mondiale."

The delegates present had no doubt that it was by holding further conferences similar to this, that the aims and objects of the participating societies could best be fostered.

The views of the Conference were summarised in a series of agreed conclusions for submission to the governing bodies of the participating societies. They have been received by the councils of the home institutions and have been supported in their entirety. They are set out in full below.

In addition, the three Presidents have communicated these findings to the Commonwealth engineering Institutions, in accordance with the duty which they undertook when the Commonwealth Conference adjourned, to act with the Commonwealth Institutions' interests in mind on any matters which might arise in the intervals between its meetings.

The three Presidents have been most pleased to receive appreciative letters from each delegation, thanking the home Institutions for their hospitality, and showing very clearly the high value which the overseas societies place on the task which this first Conference has performed, in laying the foundations of a body likely still further to promote the work of the engineering profession for the public good.

Conclusions Reached at the Conference

(I) The Conference is of the opinion that it is desirable to foster international co-operation between professional engineers through contacts between the recognised national engineering societies of each country.

The Conference therefore recommends:—

(*a*) That the present Conference stands adjourned for a period of one year, or to an earlier date according to the need; and that in the interval the principles of collaboration be developed between the participating societies through the secretariat of the present Conference.

(*b*) That further conferences of similar character be held in order to foster to the utmost the international collaboration which is envisaged.

(II) The Conference also submits the following recommendations for the consideration of the governing bodies of the participating societies:—

(1) That where advance information on forthcoming papers of a participating society can be made available, this be circulated as soon as possible to the other participati g societies, to enable note to be taken of papers of special interest.

(2) That arrangements for the invitation of visiting lecturers by one society from another may, as desired, be put in hand by communication between the secretariats of the participating societies concerned.

(3) That arrangements between the participating societies on a reciprocal basis for the extension of limited privileges of membership to visiting members from other participating societies are desirable, such arrangements being based on bilateral agreements between the participating societies and conforming as far as possible to the following pattern:—

(*a*) The visiting members of all grades to be accredited by a letter sent from the Secretary of one society to the Secretary of the other, as well as by a similar letter carried by the visiting member.

(*b*) The normal duration of the arrangements for any one visiting member to be six months.

(4) That the formation by one participating society of a branch in the territory of another is undesirable except by mutual agreement, and that each participating society should urge its members to join the national society in the country in which they live.

It is recognised as natural and proper that members of one of the participating societies residing in a foreign country may set up in that country branches to conduct meetings of a social and technical character for those members.

(5) That to assist with existing abstract services and their co-ordination and extension, each participating society agrees

(*a*) To send details of the abstracting services operating in its territory to the Conference secretariat, with a note of the periodical publications they cover.

(*b*) To consider the utility of the Universal Decimal Classification System (Brussels extension of the Dewey System) and to foster its use as far as practicable.

(*c*) That papers of the participating societies which are published in languages not widely known should be preceded or followed by brief informative summaries in English.

(6) That each participating society should be prepared to supply the names and coverage of the principal technical and scientific journals published within its territory to other participating societies.

(III) To achieve the objects which it seeks to attain the Conference considered the possibility of using the C.T.M. (Conférence Technique Mondiale), known in English as the W.E.C. (World Engineering Conference), but the Conference was of the opinion that this body, under its present constitution, is not the appropriate organisation for this purpose.

Technical Reports

The Initiation of Long Electrical Discharges.—II: Charging Currents. By C. E. R. Bruce, M.A., B.Sc., M.I.E.E. The British Electrical and Allied Industries Research Association (Ref. L/T180). Price 2s. 6d., postage 3d.—This is a continuation of the work described in the author's paper in the "Proceedings of the Royal Society, A," Vol. 183, pp. 228, *et seq.* 1944, which was issued to members as Ref. S/T44. It shows the application of the ideas therein developed, to the long laboratory spark. The conclusions from the present work are as follows: (1) There is considerable evidence indicating that glow to arc transition occurs in the leader stroke of the long spark discharge, and that, just as in the case of the lightning discharge, the occurrence of this transition may represent the onset of instability. (2) The currents required to charge the channel of the discharge as it is formed are adequate to initiate this transition. (3) The difference between the phenomena in positive and negative streamers indicates that conditions of instability governing the transition are reached initially in the discharge channel itself, and that the need for a cathode spot delays the transition in streamers from the negative electrode. (4) The difference in velocity of positive and negative streamers may account for the pronounced difference in spark-over voltage when the polarity of the high-voltage point is changed in point-plan breakdown. (5) Study of conditions of spark-over in hydrogen may be expected to lead to the elucidation of the breakdown process. (6) The study of astrophysical phenomena may also throw light on the characteristics of terrestrial electrical discharges.

Structure and Dielectric Properties of Barium Titanate and Similar Compounds. By A. F. Devonshire. The British Electrical and Allied Industries Research Association (Ref. L/T185). Price 7s. 6d., postage 3d.—The theory of the dielectric properties and crystal structure of barium titanate is discussed. It is suggested that at low temperatures the polarisability of the substance just exceeds the critical value required for self-polarisation, so that it becomes permanently polarised in domains. It is shown that if we take into account the anharmonic terms in the vibrations of the ions the polarisability will decrease with increasing temperatures. The transition to a normal state above a certain temperature is thus explained. The theory also accounts satisfactorily for the very large dielectric constants above the transition temperature and for the magnitude of the permanent polarisation in the region below the transition temperature.

The Breakdown Time of Amorphous Solids. By J. H. Simpson (H. H. Wills Physical Laboratory, University of Bristol). The British Electrical and Allied Industries Research Association (Ref. L/T 178). Price 9s. 6d., postage 3d.—Fröhlich's breakdown theory can be verified by the experimental determination of the temperature dependence of the breakdown field and the dependence of electronic conductivity on field strength. It may be desirable to apply the electrical stress for short periods only and it is therefore essential to calculate the breakdown time so that the electrical stress can be applied for a period several times that necessary for breakdown. The time to breakdown is calculated theoretically and a numerical value for soda-glass is determined.

Recording of Impulse Voltages—Theoretical and Experimental Investigation of Sources of Errors Introduced by the Measuring Circuit. By H. Tropper, Ph.D. The British Electrical and Allied Industries Research Association (Ref. L/T168). Price 15s., postage 3d.—This report contains the results of a theoretical and experimental investigation of errors which may arise when a resistance potential divider and a delay cable is used for the oscillographic recording of impulse voltages. The effect of the earth capacitance of the divider has been examined and a comprehensive analysis is given of sources of errors, which the use of the delay cable engenders. It is shown experimentally how some of these errors may be eliminated when double matching is applied, i.e., when matching of the cable is effected at both its ends. The attenuation of the cable has been measured and the result shows that this effect is by no means negligible.

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NOTICE TO READERS

All letters intended for insertion in THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

No undertaking can be given to return drawings of manuscripts: correspondents are therefore requested to keep copies.

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INTERNATIONAL ENGINEERING COLLABORATION

ENGINEERS in many lands will have welcomed the step recently taken by the Institutions of Civil, Mechanical and Electrical Engineers of this country in convening a conference of engineering societies from Western Europe and the U.S.A., the results of which are reported on another page of this issue. It is true that in advancing the science and art of their profession engineers take little account of national boundaries, and that an eminent engineer, wherever he may live, is as much respected abroad as in his home country. Yet the existence of national boundaries and national customs and, perhaps more particularly, of national languages, does impose a restraint upon the interplay of technical opinion and does hinder the free flow of technical information. Only collaboration of engineers in the countries concerned can serve to diminish that handicap. We are proud to feel that the British institutions took the lead in bringing together representatives from engineering societies of several countries to study in what ways they could help one another and engineers at large.

Those who are in a hurry to set up international bodies and who believe that the time is ripe for the creation of such societies will be disappointed with the results of the conference. For in truth it must be admitted that not a very great deal seems to have been effected. In the past engineering societies in different lands have, as occasion offered, given each other assistance by providing information or advice, by helping to find suitable lecturers, by assisting engineers from other countries and by making copies of technical papers available when asked to do so. The main work of the recent conference was to put such activity upon a more orderly basis. Advance information upon forthcoming papers is to be circulated amongst the societies as a matter of routine. Steps have been taken towards co-ordinating and improving abstracting and similar services in the countries concerned. It is to be but an ordinary facet of a society's activities that assistance shall be given if required in transmitting invitations to lecturers to visit other countries. Bilateral agreements are to provide for the extension of limited privileges of membership to visiting members from other participating societies. It seems at first sight all rather "small beer," though certainly useful. Yet all things have to have a beginning. Immediate concord on points other than the fairly simple ones upon which agreement was, in fact, reached could not reasonably be expected. Too many factors clearly exist that prevent wider present agreement. The educational standards demanded by the societies of their members are, for instance, unlikely to have proved equal. Quite certainly there are differences in the extents of the engineering field covered by the activities of the societies. The Swiss society, for instance, appears to cover architecture as well as engineering. Though the societies were certainly formed with the common purpose of serving the interests of engineering skill and science, there is yet plenty of scope for their general policies to differ. In fact, upon a little consideration, it is seen that merely to have brought representatives of the societies to an international conference where each could be enlightened about such points of difference would by itself have justified the trouble taken even had no agreements been reached immediately. The greater understanding generated, we think, is certain to prove of assistance at the future conferences which it is intended to hold in gaining agreement upon further methods of collaboration. Even at last month's conference it made possible agreement upon one item that seems to us particularly significant. As one of the conclusions of the conference it was agreed "that the formation by one participating society of a branch in the territory of another is undesirable except by mutual agreement, and that each participating society shall urge its members to join the national society in the country in which they live." It is true that this forthright statement is immediately followed by another which seems almost to contradict its intention. But in present circumstances the first statement could hardly be permitted, on practical grounds, to stand unqualified. For, on the one hand, many such branches of foreign societies already exist in the countries concerned and, even when they do not yet exist, no society can at present be expected actively to resist the desire of a sufficiently large group of its members to set up such a branch if they so wish; and upon the other, until such a time (as may perhaps come in the future), when papers presented in one country become easily available for circulation by another society in its own territory, there must always remain an urge for residents in a foreign country to join their own national society in order to receive its publications. Nevertheless, the agreement, qualified though it is, indicates a recognition of the special situation of a society in relation to its own country, and it does imply presumably that societies will no longer actively attempt to extend their membership abroad. A possible "bone of contention" is thereby removed and the way opened for further friendly co-operation.

It is abundantly clear that the association between the societies whose representatives attended this conference is still very loose. But it is also certain that during the present year there will be a much greater exchange of information and of general assistance than there has been in the past. It will be taking place not only between the societies present at the recent conference, but also between the major institutions in this country and corresponding bodies in the Commonwealth with which similar arrangements were made at a conference held in October, 1946. One is tempted therefore to speculate as to what future developments may be. Yet we think such speculation somewhat idle and not altogether desirable at present. For international bodies do not easily function. Differences of national temperament and custom and differences of language may very easily lead to misunderstandings and even jealousies fatal to real collaboration. In consequence, it is, we think, better that the societies concerned should feel their way cautiously towards that closer association that they themselves probably feel to be desirable than that the thing should be too hastily done. The societies have undoubtedly set out upon the right and a very welcome road. Where they have found agreement easy to reach they have recorded it. Where they have thought it too difficult they have either left the matter over in the hope that time or events may make agreement possible in future or not discussed it at all. If conferences are held regularly in years to come, as is the present intention, the goodwill that has already consciously been generated amongst them may well develop into an unconscious habit of mind. Then collaboration between them can confidently be expected to adjust itself flexibly and almost automatically to just the extent that prevailing conditions in the future may dictate to be desirable.

FLYING THROUGH STORMS

SOME surprise may have been felt by those who read the Press accounts of "Exercise Sunrise," lately carried out off our southern coasts by units of the Navy and R.A.F., that the defending aircraft taking part, or intended to take part, showed themselves to be so severely restricted in their action by the weather, which chanced to be exceptionally violent. But it is easy to forget that land operations are no less liable to suffer from the vagaries of the weather, sometimes by reason of loss of adequate visibility owing to dense fog, sometimes when Army tanks and other vehicles become bogged on cross-country journeys, and in many other ways. Even naval surface craft, great

or small, cannot fight in a tornado—indeed, radio methods of range finding and gun sighting are especially liable to interruption by the usual electrical accompaniment of such storms. In the particular exercise to which we refer the cloud bank was reported to be unusually low, very highly electrified and many thousands of feet in thickness, with a marked tendency for ice to form on any aircraft that flew. Even the 10 million candle-power flare dropped in the improvised mock atom bomb attack was hardly seen.

It is now recognised that if, for any reason, one of the opposing sides in such exercises, as in actual warfare, has access to more trustworthy meteorological information and can make better use of it than its opponent, it will be at great advantage. We have moved far indeed from the days of the first World War when, so the story goes, a brilliant young scientist (now a leading authority) offered his services as a meteorologist to the War Office and was told by the general he interviewed: "Young man, the British Army fights whether it is raining or not. Good morning"! That tne influence of weather is now better grasped is due to various factors: the wider geographical area of fighting capacity, the greater dependance on instruments of precision and, not least, the far higher speed of action. The influence of increased speed is especially notable in air operations. In the first World War it was rare to fly much over 100 m.p.h.; to-day 600 m.p.h. is not uncommon, and speeds still higher have been reached by special aircraft and will before long become common. This change makes the task of aircraft design notably harder, since the stresses due to flying at such speeds in gusty weather are much increased. Vertical currents in the atmosphere of over 30ft per second are common enough, but it is known from the size of the hailstones that velocities as high as 100ft per second are possible. The resulting high accelerations, and the high stresses that go with them, call for sturdier construction and therefore increased structure weight, always the bugbear of the aircraft designer, unless by ingenious invention some way can be found for minimising the effect, as, for example, by automatic reduction in the angle of wing attack when the disturbed area is entered. It is not uncommon also to hear of aeroplanes being struck by lightning, but rare to find any serious damage reported as a result. This is possibly an effect of the exhaust stream in maintaining the aircraft at the surrounding electrical potential and thus greatly reducing the electrical stress. Dangerous cloud formations while still at a distance can now be detected by radar, as can usually any heavy rain clouds; but in the smaller aeroplanes it is not easy to find space for the housing of the many instruments which the user, if not the designer, would like to carry. When one reads of aircraft carrying electrically operated devices incorporating radio valves by the hundred, one realises how long and complex is the list of instrumental "gadgets" from which a choice, however difficult, must be made. Although these difficulties are chiefly encountered in military aircraft, they arise in some measure in those used on civil airways. There the matter is simpler, since the speed, and its rate of change, is usually much less, and the space for instrumental aids appreciably greater; it is, moreover, not the civil pilot's operational business to look for trouble, much the contrary indeed.

One of the problems now under consideration is that of the pilot's attitude in fighter aircraft, which may conceivably arise some day for other types also, and by attitude we mean, not his mental, but his physical relationship to his duties. The brothers Wright, when they made their first pioneer flights, nearly half a century ago, planned their pioneer aircraft so that the pilot lay prone on his chest with his feet towards the rear: that position was soon generally abandoned, but somewhat unexpectedly we now find it being again considered. Normally the highest accelerations occur during a tight turn, and this, with the usual position in which the pilot sits, induces a downward flow of blood from the brain sufficiently marked to lead to a temporary loss of vision; with most pilots 5g can produce this effect. It is a great hindrance in fighter aircraft in any weather, but with a prone position the physiological effect would be much less and, incidentally, the cockpit lay-out might be substantially eased, especially in the case of twin-engined fighters. This possible reversion to Wright Brothers' procedure is under survey and there will no doubt be much argument on both sides. But it does seem that it should make fighting manœuvres, especially in boisterous weather, far less trying to the military pilot.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

BRITISH MACHINE-TOOL INDUSTRY

SIR,—I feel that Mr. C. A. Ferney's articles on the British Machine Tool Industry in your issues of December 17th and 24th call for some comment. Mr. Ferney has dealt with his subject in a most interesting manner, but I am of opinion the question of machine-tool utilisation to which he refers, is one about which it is not possible to obtain a true perspective by dealing with an average figure for the engineering industry as a whole.

He mentions that average British users of machine tools only obtain approximately 50 per cent utilisation from their plant as a result of which, Mr. Ferney considers, a poll-type survey of machine-tool utilisation should be undertaken, no doubt with the idea of obtaining data which would provide a basis for attempting general improvement in this figure. The question arises as to whether a low average figure provides sufficient basis to warrant a survey of the engineering industry. Before such a step is taken, if indeed it is necessary, I suggest an average figure for utilisation must be broken down, not only for the various classes of manufacture too numerous to mention but for the various industrial areas of the country. Conditions in no two works are alike and according to the class of manufacture being undertaken, so I suggest must the target for maximum utilisation be adapted to suit the particular conditions which obtain.

For instance, consider a high production unit manufacturing, say, engines for motor-cars. The throughput would be of the order of 2000 to 3000 engines per week, which warrants a large expenditure on the comprehensive provision of elaborate time saving jigs, tools and fixtures. Thus, with this plant, other things being equal, you should have a high rate of utilisation.

On the other hand, take a general engineering company with modern plant, mainly on a sub-contract basis, producing equipments in batches of, say, 100 at a time. The manufacture is tooled to the economic limit allowed by the value of the company's orders and the quantities involved but because the amount of money which can be allocated to tooling is limited, it is not possible to provide such time-saving items as air-operated fixtures and similar quick-acting mechanisms. Thus, the handling times in this case will not compare favourably with similar times in the works producing engines for cars, with a resulting lower utilisation of plant. I suggest, however, that in many cases general engineering works in this country, by virtue of their circumstances, have as high a rate of utilisation pro rata, as the mass production unit, and with the aforementioned conditions in mind, I consider that any average figures which are quoted for machine-tool utilisation may only be misleading.

I would like to mention one further point, namely, that Mr. Ferney appears to do production engineers in this country an injustice when he mentions that a cursory investigation tends to show that British jig and fixture design may be behind best foreign usage, the reason being, when compared with American practice, that production engineers here have but a limited experience of fast rates of metal removal. The rate of metal removal is, I suggest, not always the first item for consideration when designing jigs and fixtures, rather the reduction of handling time to a minimum and perhaps the most important, the continual reproduction of accurate results. Designs in this country of jigs and fixtures for general engineering work will, I think, compare most favourably with similar installations in any other country, including America.

J. G. LLOYD.

Ealing, W.5, January 7, 1949.

TOIL

SIR,—You have done a service with your excellent leader on the above subject in your issue of December 24th. It has exercised my mind for many years and it is to be hoped that some industrial body will give serious attention to it, for I can see no solution.

As a machine-tool designer who has been responsible for considerable cheapening in production costs, I must admit to a feeling of disappointment in the fact that new and faster producing equipment seldom gives any relief in the manual effort of the operators.

As I see the problem, this little island of ours has to export sufficient merchandise at the lowest prices to pay for the food which it cannot produce itself to maintain its population. Also the manufacturer presses for cheaper production to strengthen his position. Special machines and equipment are installed. The designer fondly imagines that in addition to quicker production, the effort of his fellow workers is to some extent reduced. The production engineer then gets busy to extract the maximum effort from both machines and operators, supported by his management's policy and the national appeal for more production, the outcome being that there is no physical relief to operators. Many operators become redundant. After an interval of a few years product costs are trimmed to the normal profit margin—to meet competition—after providing for improved factory and welfare amenities. The designers of this improved equipment, if they have any social interest, are forced to the conclusion that their function is circumscribed to their own department.

To quote one case in the writer's experience, a girl now produces—regardless of number of machines—thirty times the quantity that she would have produced twenty-five years ago and her lot is in no way improved.

This speeding has in some factories been

carried out to the extent that it would seem that only raw labour will, rather than can, be recruited to it.

As I said before, I see no solution to this single problem, and my only purpose in writing is to encourage a more critical attitude to speed in production.

A tentative suggestion that the chief designer or his nominee should be a party to any agreement upon the speed of machines and other producing equipment, recognising his desire for all speed possible compatible with the mechanics of the plant and the physical effort of the operators, does not carry weight. There must be a general recognition of the problem.

C. J. POTTS

Coventry, January 5th.

PERSONNEL MANAGEMENT AND WORKS MANAGERS

SIR,—Mr. Rice is to be congratulated on the pithiness of his article; some writers would have needed a book to cover the same amount of ground.

The position of the personnel manager must necessarily be anomalous as long as the remnants of hire and fire mentality exist among those responsible for policy. Full employment, guaranteed working weeks—whether these are universally practicable or not—are sufficiently in the foreground of all constructive thinking on the subject to show all who are not deliberately blind what a long way we have come from the days when a little "welfare" was indulged in to show what a model employer one was.

It is probably true to say that good labour relations are as vital as efficient plant, sound finance and good salesmanship, but the status of many personnel managers, little more than welfare superintendents, gives little evidence of this.

In many works there is an assistant works manager: given the necessary human qualities and the right relationship with the works manager, he can well be the most suitable executive to deal with personnel matters. His status is high enough to confer the necessary authority, while still being subject to the essential overriding control of the works manager. If he does not have the specific title of personnel manager this may be all to the good: the tidiness of an organisational tree is no guarantee of the soundness of its timber.

W. COPPEN BARTLEY

Brighton, 6, January 6th.

THE STATUS OF THE FOREMAN

SIR,—It appears that Mr. Knight, in his letter in your issue of December 31st, has made the common error of assuming that because he has made a statement it automatically becomes a fact.

A dictionary definition of a fact is that it is "a thing certainly known to have occurred or be true."

He says we must accept the fact that few employers are good employers, &c., and also the fact that, under certain conditions, foremen will be underpaid or badly treated.

These statements may or may not be true, but they are not facts, but expressions of opinion.

My own experience is the reverse of Mr. Knight's and I find most of my associates look on good foremen as most valuable members of the industrial community and treat them as such, and not as "essential yet costly overheads." They are indeed the N.C.O.s without which no regiment can carry on.

I would repeat, however, that these remarks are only expressions of my opinion and not facts.

I. A. CURREY

Bradford-on-Avon, January 2nd.

Civil Engineering in 1948

No. II—(*Continued from page 22, January 7th*)

IN the first part of this article, last week, we briefly described the progress during 1948 of the major schemes of the North of Scotland Hydro-Electric Board. In connection with those works it only remains to refer to one of the pages of the Supplement to this week's issue, which shows the Loch Sloy dam and one of the Tummel-Garry scheme works, the Clunie dam, under construction.

NORTON DAM, DOWNSTREAM FACE

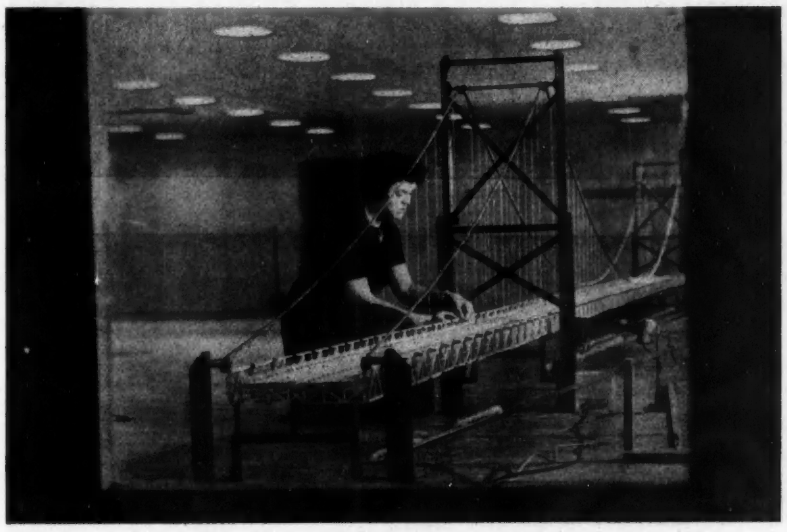
CEYLON HYDRO-ELECTRIC SCHEME

Before turning to an account of other types of civil engineering work, reference must be made to an interesting scheme in Ceylon for the production of hydro-electric power. Near Adam's Peak, Norton dam has been nearly completed and a head of roughly 1500ft has been obtained with a flow of 500 cusecs, to develop 50,000 kW. Water has been diverted from above the Aberdeen Falls on one tributary of the Kelani Ganga, to the base of the Laxapana Falls on a parallel tributary, to produce this head. Norton dam, 345ft long and 108ft high, is illustrated herewith. Flow from the reservoir is taken through a concrete-lined tunnel 1½ miles long to a surge chamber and thence through 48in diameter welded steel pipelines a mile long to the power-house, where three 8333-kW Pelton-wheel sets are being installed as a first stage. Power will be transmitted over a 66-kV line 52 miles long to Colombo and other parts of the island.

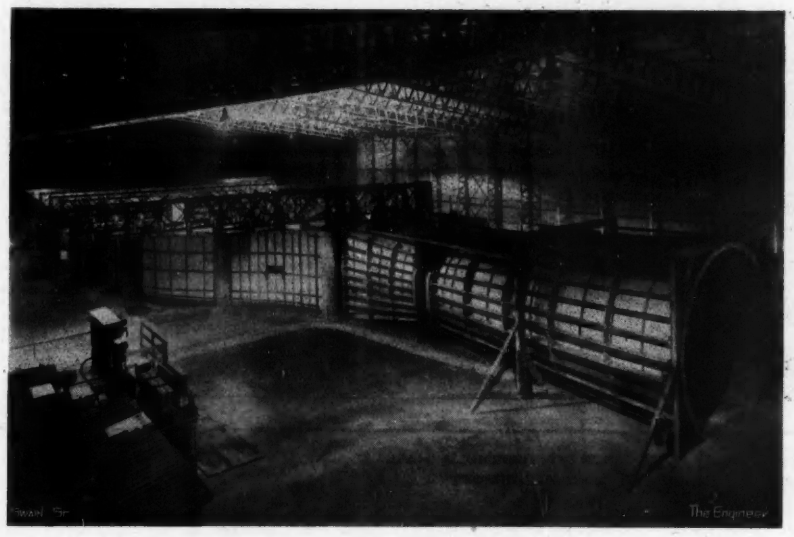
Norton dam, with its road bridge over the crest, is practically completed, but a flood gap has been left until the scheme goes into operation. Civil engineering work is sche-

CLAERWEN DAM SITE AND CABLEWAYS—NORTH WALES

TIDAL MODEL OF FIRTH OF FORTH



MODEL OF SEVERN BRIDGE



WIND TUNNEL FOR SUSPENSION BRIDGE MODELS

duled for completion early in 1950, when the first stage will be in service. An interesting part of the work is a rail haulageway, three miles long alongside the pipeline, built to transport heavy equipment to the power-house and to erect the pipeline. The consultants for the scheme are Messrs. Preece, Cardew and Rider.

Claerwen Dam

Work on the construction of Claerwen dam in North Wales, which is being built for the Birmingham Corporation Water Department, is now in its third year. Considerable delays were experienced in obtaining the extensive plant required, but during 1948 the contractors completed that part of the work and the plant is now being run-in. As our illustration shows, twin cableways, each with one fixed and one travelling mast, have been erected for concreting; there is a modern concrete batching plant on one side of the valley and a diesel power station to generate electricity for the plant. A quarry near the site supplies aggregate. The soft and rock excavation for the dam is about 75 per cent complete and by the end of the year a start had been made on the concreting of the dam and the grouting of the cut-off trench.

Claerwen dam is expected to be ready in three years' time. An illustrated description of the scheme was given in our issue of December 6, 1946. The chief engineer of the Birmingham Corporation Water Department is Mr. C. A. Risbridger, and the engineers for the dam are Sir William Halcrow and Partners; the contractors are Edmund Nuttall, Sons and Co. (London), Ltd.

Use of Models

Two particularly interesting instances of the use of models for civil engineering projects formed subjects of articles in these columns during the year. The tidal model of the Firth of Forth (issue of May 14, 1948) was built by the National Physical Laboratory to investigate silt deposition in the region of Rosyth Dockyard, where much dredging has to be carried out. This large model, illustrated herewith, is some 80ft long and is on a scale of 1 in 1800 horizontally and 1 in 144 vertically. All the main contours between Edinburgh and Stirling are represented, but attention has been concentrated on reproducing the tidal movements between the Forth Bridge and Charlestown, with accuracy. The mechanism reproduces a 12·4 hour tidal cycle every five minutes, with means of simulating the effects of spring tides at appropriate time intervals. It is proposed to investigate the use of training walls and other works to change the regime, so as to lessen the deposition of silt in the dockyard areas.

The other model described in our issue of October 29, 1948, is of the proposed Severn suspension bridge, and forms part of the experimental work of the National Physical Laboratory on behalf of the Ministry of Transport. It was built for use in the new wind tunnel at Thurleigh, near Bedford, expressly constructed for experimental work on the oscillation of suspension bridges under varying wind strengths and directions. As our illustration shows, the model is complete in detail; it is built to a linear scale of 1 in 100, has a central span of 30ft, and has a total length of more than 50ft. It is constructed of light, rigid components, with steel interconnecting springs, adjusted to give the necessary overall stiffness, and it offers wide scope for variations of structural form. The wind tunnel at Thurleigh, illustrated herewith, has been built in a disused aircraft hangar.

Space in this article does not permit a

AERODROMES UNDER CONSTRUCTION IN 1948

FILTON RUNWAY AND AIRCRAFT ASSEMBLY HALL
HEATHROW AERODROME, LONDON AIRPORT

full description of these interesting models, nor of the experimental work with which they are connected, and we can only refer our readers to the fuller descriptions cited above. But the importance of such work cannot be over-rated, for the preliminary researches, costly though they are, should lead to much reduction of expenditure when the actual works are put in hand.

Aerodrome Construction

Rapid developments in aviation have set new problems for the civil engineer, in constructing economically the immense runways required for aircraft of the size of the "Brabazon," weighing nearly 130 tons. The runways for such a class of aircraft are now tentatively required by the International Civil Aviation Organisation to be 2830 yards long and to be laid in at least three directions to allow landings and take-off in any wind. It seems that aircraft wheel-loads may eventually reach a value of between 35 and 40 tons, and that two such wheels may act close together.

The runway at the Bristol Aeroplane Company's Filton aerodrome is now completed. An illustration on the opposite page gives an indication of its size.

Designed specially for the "Brabazon" aircraft, to the requirements of the Ministry of Supply, the runway, which is 2750 yards long and 100 yards wide, was constructed on a stabilised soil base, by John Lang and Son, Ltd. Contrary to popular belief considerable length of runway will not be needed by the "Brabazon" for take-off, but will be required primarily for experimental and test purposes. When the machine is being tested it will now have a sufficient runway length to allow a short hop to be made, followed by reloading, without the necessity for a manœuvring flight.

The second illustration opposite shows the stage reached in the construction of London Airport, Heathrow, Middlesex. In all, it is proposed to build ten runways, but the final stage of construction, when further runways will be built to the north of the Bath Road, is not scheduled for completion till 1953. At present the main runways run east and west, with subsidiary runways at 60 deg. The main primary runway is 9500ft long, with extensions to form a strip length of 10,500ft, whilst the main secondary east-west runway, which was originally built for the R.A.F., is even longer, measuring 11,570ft, with a strip length of 14,570ft, or about 2¾ miles. The maintenance and workshop areas are outside the landing areas, but the terminal buildings are in the centre, on a site of 66 acres. At present the airport is equipped to handle, in good weather, forty to fifty aircraft and 1000 passengers an hour, but on completion it is thought that more than 100 aircraft and 4000 passengers an hour could be cleared.

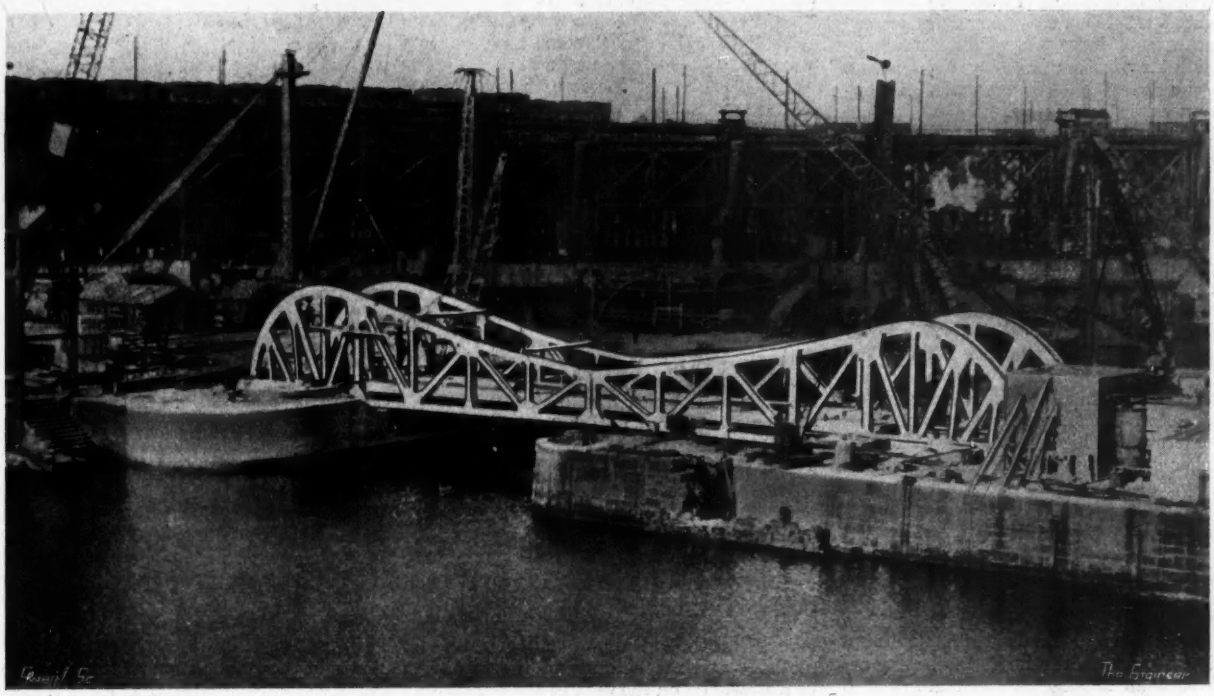
Hendon Dock Bridge, Sunderland

An event of the year was the opening by the Minister of Transport of Hendon Dock Bridge, Sunderland Docks, at the end of November. A full, illustrated description of this very interesting structure and of the dock improvement scheme appeared in our issue of December 3, 1948, but the following brief particulars, together with the illustration herewith, will serve to indicate the main features.

Amongst the port improvement works of the River Wear Commissioners put in hand, at a total estimated cost of £800,000, is the equipment of the east quay of Hendon dock to handle general cargo. To allow the entry of larger ships to this quay the entrance from Hendon dock is being widened and deepened. The work involved the removal of the existing swing bridge and its replacement by the bascule bridge illustrated, as a matter of urgency, to permit traffic to cross the gap whilst the dock improvements were in hand.

The new bridge is of no great size. It derives its peculiar interest because its moving parts are made from aluminium alloy. Its span between the centre lines of trunnions is but 121ft 1½in and the clear waterway is to be 90ft wide. The operating machinery is designed to raise and hold the bridge in any position against a wind load of 15 lb per square foot. The bridge carries a 9ft roadway with a single railway track and two 4ft 9in footpaths.

The superstructure of the bridge was designed and fabricated by Head, Wrightson and Co., Ltd., of Middlesbrough, in aluminium alloy, as a double-leaf trunnion bascule. Kentledge boxes, rails and other small details are made of other materials, and the use of aluminium alloy has been confined to the movable parts, since no advantage would have been gained by using other than mild steel for the fixed parts. Working stresses in the alloy are 7 tons per square inch tensile and 4·35 tons per square inch shear. Mild steel rivets were used throughout, and to prevent electrolytic action, the whole of the aluminium alloy, including rivet holes before the insertion of rivets, was painted with zinc chromate. Because of the light weight of the aluminium structure, Head, Wrightson and Co., Ltd., was able to construct the movable parts at Thornaby-on-Tees and float them by motorship to the site. A light crane then served for erection.



Hendon Aluminium Bridge

The machinery for operating the bridge is placed below ground-level, where a pinion engages with a curved pin rack at the tail end of each truss. Each leaf is operated through reduction gears by two 25 h.p. motors, but in the event of one motor failing whilst raising the bridge the other can continue the operation quite safely. When in the down position, the bases are locked to each other by two steel bolts, which ensure that the leaves deflect together as a load passes over the bridge. These bolts are driven by a 3 h.p. motor through gears and are controlled from a master controller.

In the aluminium bridge the structural weight of the moving parts is 86·5 tons and there are 130 tons of kentledge. A similar bridge in mild steel would require 180 tons for the structure and 270 tons of kentledge.

The whole of the work is under the direction of Mr. W. H. S. Tripp, chief engineer to the River Wear Commissioners, who is also responsible for all design other than that of the bridge superstructure.

Labour in 1948

By GERTRUDE WILLIAMS*

No. II—*(Continued from page 7, January 7th)*

Former Depressed Industries

CERTAIN basic industries had been amongst the chief sufferers of the prolonged depression during the inter-war years. Thousands of men and women had left them in search of employment in the expanding consumption industries that were rapidly developing in the Midlands and the Home Counties; yet, despite this exodus, the percentage of unemployed amongst those who remained rarely fell to a figure which was less than twice the average for the whole country, and great efforts were made to persuade the workers that their future must lie in entirely different occupations. Twenty such years leave an impression which cannot be removed quickly. The thousands of men and women who eagerly snatched the opportunity, offered by the war, to leave for ever the industries in which they had suffered so much, cannot easily be induced to return now that circumstances have changed and they are needed so badly. Both in coal mining and in textiles, the average weekly earnings have risen since the war considerably more than in most other occupations, but this has not been enough to attract the supply of recruits that is required. Good wages can be earned in other industries, which have a happier record of steady employment and in factories which are not only well-equipped themselves, but which are situated in localities which never wilted in the gloom of prolonged depression. It is doubtful whether any increase in wage rates which is economically feasible would be sufficient to attract really adequate supplies of workers; for higher wages are reflected in higher selling prices and there is a limit to the prices that buyers are willing to pay. The sellers' market in textiles is already coming to an end and the expansion of exports in the future must rely much more on the ability to quote competitive prices than has been the case during the last few years. As far as coal is concerned the world demand still seems insatiable but a rise in its price on the home market would cause such an increase in the costs of production of manufactured goods as to jeopardise the amount of their sales abroad.

Faced with this dilemma, the Government has tried two remedies: (*a*) a compulsory reallocation of labour from less essential to more essential industries, and (*b*) an absolute increase in the total labour supply. Both have had some success, neither has been wholly successful. By dint, on the one hand, of persistent propaganda, backed by the Control of Engagement Order, and, on the other, of the import of foreign workers, pledged to enter undermanned occupations, the labour force of these industries has been increased but, despite all efforts, it has remained far below the amount required. The targets set for coal of 750,000 workers and for cotton of 325,000, by the end of 1948, have not been reached. Coal had managed to rise only to 738,000 by the end of November, and cotton to 278,000; and it has begun to be recognised that the objective must be reached by other routes.

Output per Worker

What other routes are available? Only two—longer hours of work or more output per hour. Labour supply can, of course, be increased by each man working longer as well as by an additional number of workers, but the whole trend of working class thought is strongly opposed to this. Most industries are necessarily situated in congested urban areas, so that it is not unusual for the majority of the workers to have as much as a couple of hours' travelling to add on to the working day. There does not seem much point in wearing oneself out earning more money when one has no leisure time in which to enjoy it. The voluntary agreement made last year by the miners to work an extra shift in order to meet the great demand for coal has certainly not proved very much use in practice, and it is highly doubtful whether any serious attempt to lengthen hours of work in other industries would be any more successful.

This leaves only the second of the two alternatives. If you cannot add to the number of workers nor increase the number of hours each man works, the only way to increase output is to increase the output per hour; and it is the realisation that this is the one remaining solution to the problem that has persuaded the Trades Union Congress to make this bold change of front.

T.U.C. and Productivity

The November conference called by the T.U.C. and attended by 1350 members of the executive committees of 144 unions agreed, with only four or five dissentients, to give immediate and sustained consideration to methods of dealing with practical problems of increasing productivity in the industries with which they are connected. In the report prepared by the T.U.C. for the conference this is recognised to mean much more than the readiness to abolish restrictive practices, valuable as this in effect might be. It implies a will to co-operate in a more positive way in a study of the best use of the available manpower (or what it is now fashionable to call "the redeployment of labour"), the introduction of the best methods and machinery and the spreading of education "on the floor of the workshop" so that the consequent changes in the everyday work of the rank and file may be accepted without friction.

In this revolutionary change from its traditional policy the T.U.C. has taken a remarkable step forward but it is yet too early to see what results it will have in trade union action. We often deceive ourselves by talking of trade unions as if they were all alike or of "the trade union movement," as if each union were merely a branch of a society which was controlled and organised by a central headquarters. In fact, of course, the T.U.C. is only a co-ordinating body of independent societies and can wield no more power over their individual policies than they are willing to grant it. Its position *vis-à-vis* its affiliated unions is pretty much the same as that of an international body towards its member countries and trade unions are no less determined than political units to maintain their full sovereignty.

Recognising this, the T.U.C. has urged the importance of bringing home to the workers in each industry the seriousness of the problems that face it and proposed that this first general conference should be followed by a series of consultations with different groups of unions, with whom would rest the responsibility for formulating and carrying out the necessary active policies.

The difficulty the T.U.C. is up against is that the man in the workshop cannot shake off overnight the fears that have been bred in him over so long a period—fears that were voiced by Mr. McDougall of the Amalgamated Union of Foundry Workers, one of the few to speak in criticism of the T.U.C. policy at the conference, when he said that it was based on the assumption of full employment, and that few workers had confidence that this was likely.

Workers and Labour-Saving Machinery

There was dramatic confirmation of this view in the strike of a number of London dock workers that took place in the same week as the conference, as a protest against the introduction of labour-saving machinery. There is nothing new in such a protest; it is as old as the Luddite riots; for workers, less wise than King Canute, have always believed they could make the tide turn back. But now that there is so keen a demand for workers displaced by changing techniques, there is less sympathy than there used to be in the years when redundant workers might find themselves out of work for months or years. And yet it is possible that we now go too far in our condemnation of workers who try to dig themselves into their present occupations. It is easy enough to show how uneconomic is their policy in the long run. If everybody always resisted the use of better tools or more efficient methods because it involved some personal adjustment how could we ever have reached our present standard of living or hope for any improvement on it? But as we live our lives as individuals or as members of a family it is just these personal adjustments with which we are particularly concerned and which determine our judgments. Improved methods may, in the long run, be better for the whole community but, in the meantime, here and now, they mean that there is no longer a place for me in my old work and the bottom falls out of life. True, there are other jobs I can go to, but that may involve me in quite a different sort of life from the one I am used to, perhaps with different hours of work or rates of pay. And suppose it means moving to another district, will I get a house and what about the wife and children—will they like the idea? Of course, these adjustments have to be made. If we want a higher standard of life we must pay for it and being prepared to change when the need arises is part of the price. But there is no purpose served and a great deal of harm done by the lack of sympathetic understanding which allows one to take a high moral tone in condemnation of those who have to bear the chief brunt of the change; and who react to the new methods as almost all the rest of us would do in like circumstances if all the familiar landmarks of our life were threatened. Think of the cavalry's opposition to the tanks!

It will take a long time before the confidence in full employment eradicates the fear of change from the mind of the ordinary wage-earner and makes it possible for him to think of the term "labour-saving" as expressing something which makes life easier for him rather than something which destroys his living. And even full employment cannot work the trick unless great care is taken to ensure that those whose labour becomes redundant because of improved techniques are rapidly absorbed into other occupations with comparable rates of

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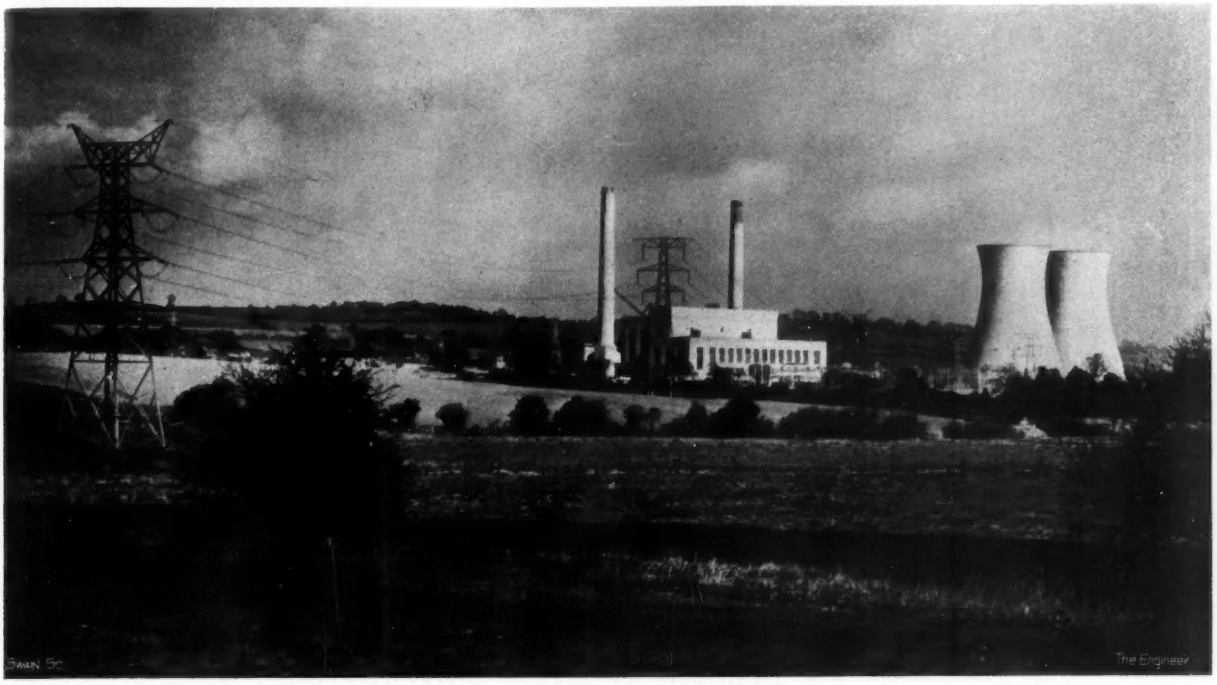
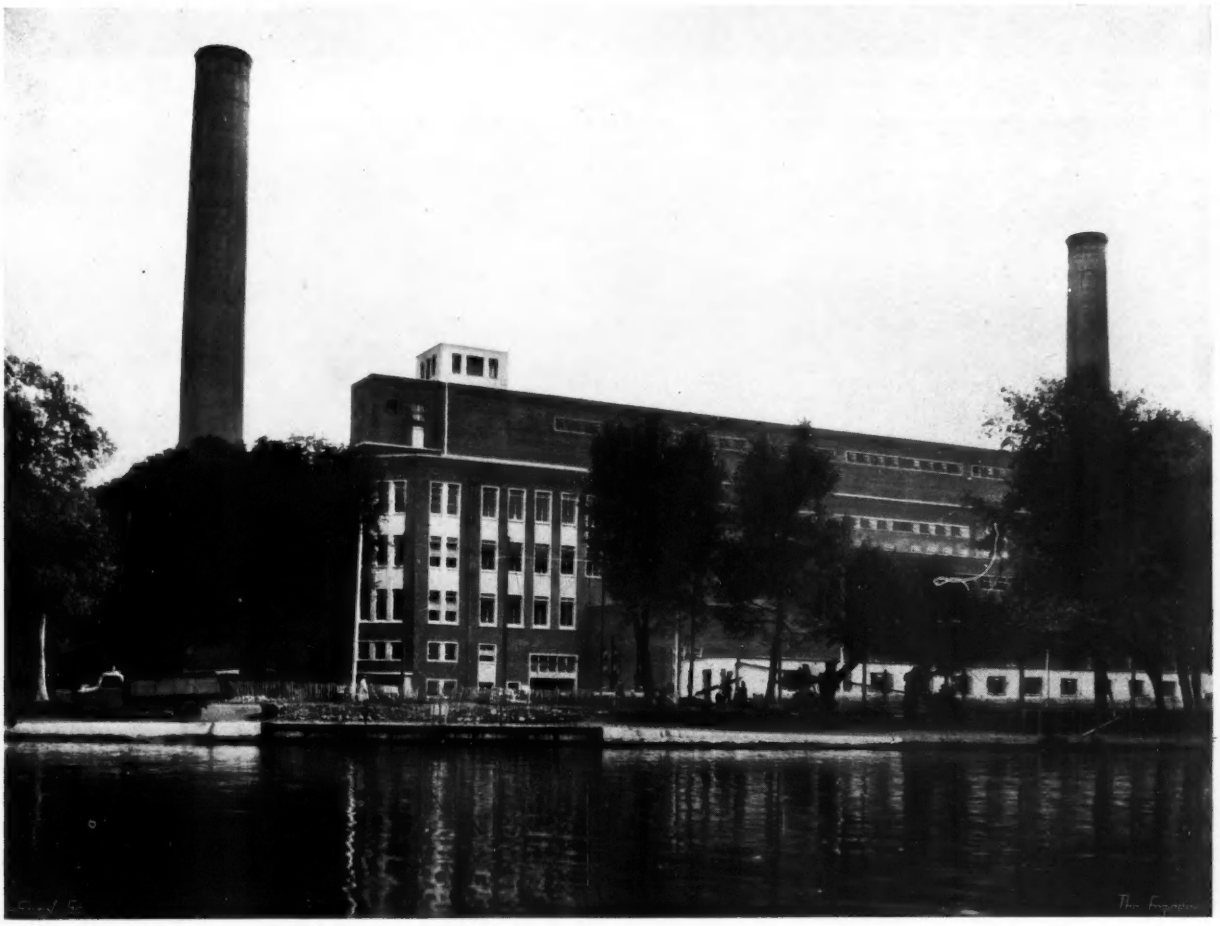
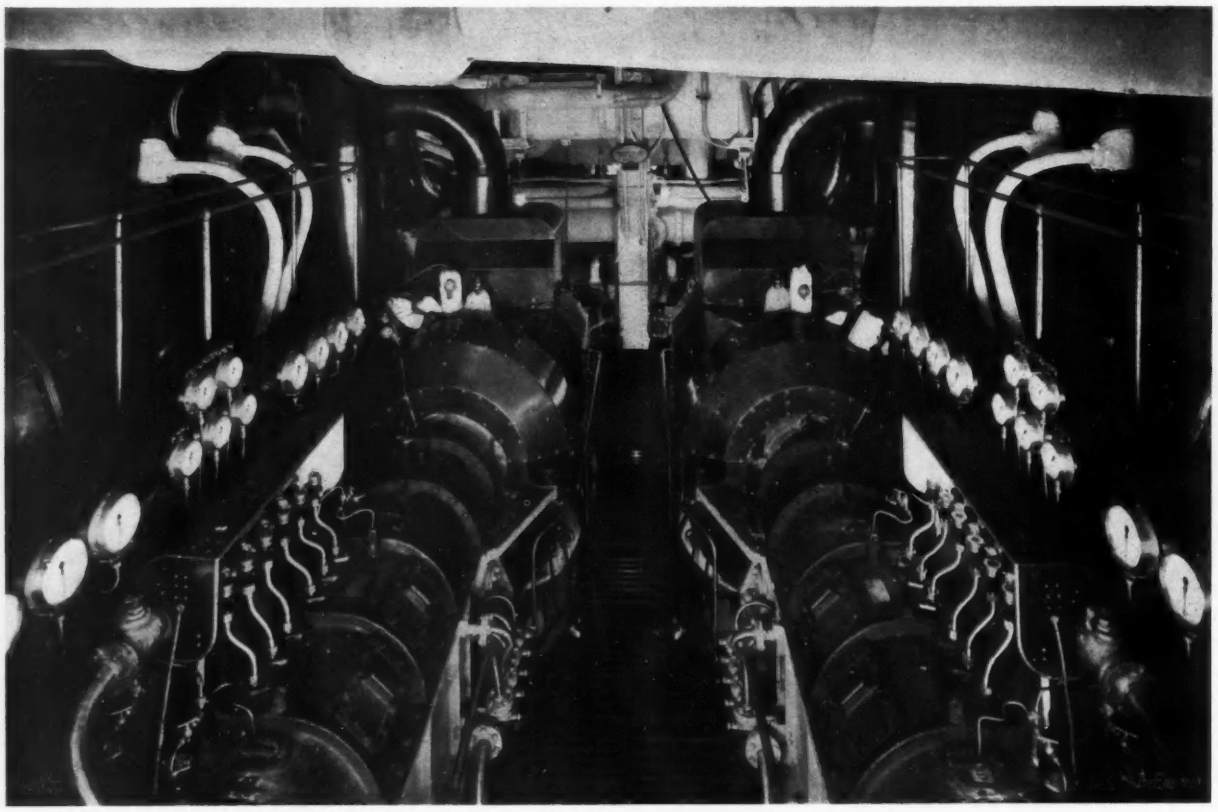
TWO POWER STATIONS OF 1948





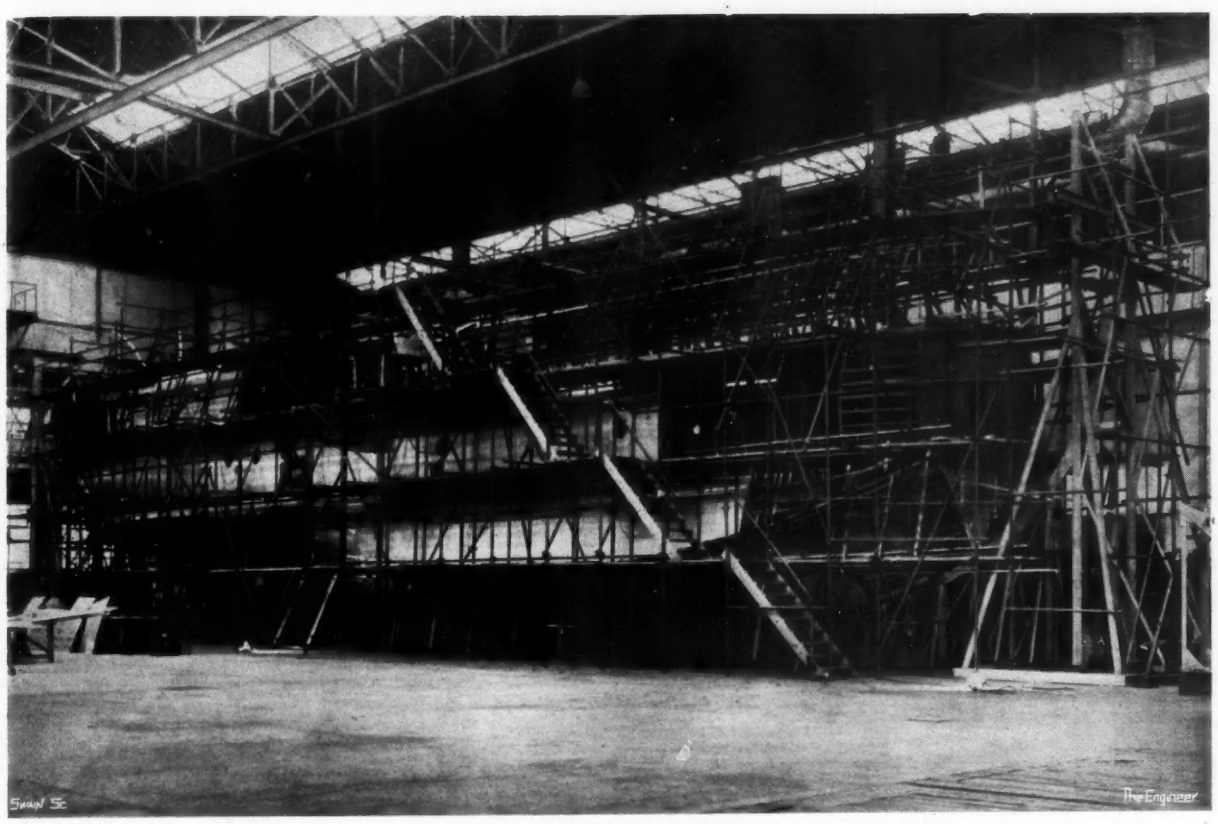
MEAFORD POWER STATION
KINGSTON POWER STATION

MARINE MACHINERY OF 1948



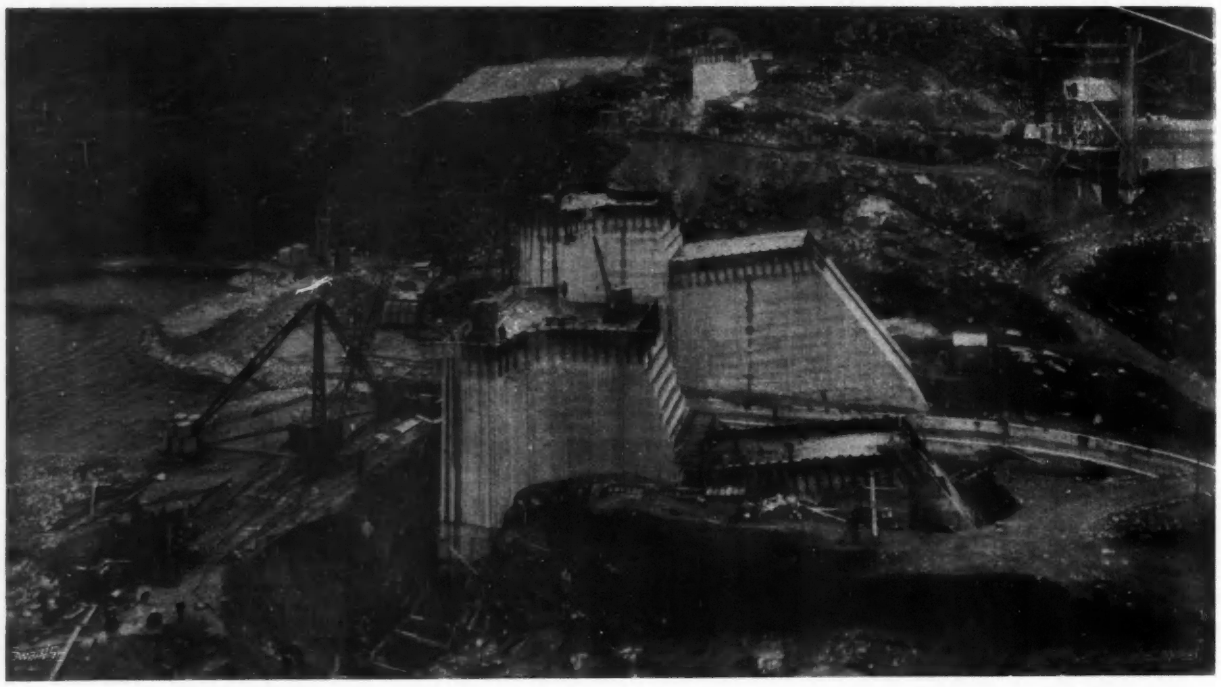
H.P. AHEAD TURBINES AND GEARING OF ORIENT LINER "ORCADES"
BOILER-ROOM OF CUNARD WHITE STAR LINER "CARONIA"

LARGE AIRCRAFT UNDER CONSTRUCTION IN 1948



SAUNDERS-ROE "S.R.45" FLYING BOAT UNDER CONSTRUCTION AT COWES
BRISTOL "BRABAZON I" NEARING COMPLETION IN THE ASSEMBLY HALL AT FILTON

DAMS FOR SCOTTISH HYDRO-ELECTRIC SCHEMES IN 1948



LOCH SLOY DAM
TUMMEL-GARRY PROJECT—CLUNIE DAM

pay, and are helped both by their new employers and their fellow workers to establish themselves as members of a new community. But however carefully and sympathetically a change is arranged it cannot help but mean suffering and it is foolish to pretend otherwise. It is part of this modern world in which we have all become so much more closely involved with one another, that it demands from us a much greater sense of social obligation than before. We can no longer blind ourselves to the fact that self interest often runs counter to social needs and that it must sometimes be subordinated to them. But it is better to face this honestly and not to try and convince people that a course of action is to their direct and immediate interest when they can see quite clearly that it is not.

The Miners

This conflict between individual interest and social obligation is illustrated again in the problem which has proved one of the toughest of all nuts to crack—the high incidence of absenteeism amongst miners. Let us recognise at once that much of this absenteeism is involuntary. Mining is an extremely dangerous and exhausting occupation and the miners are an ageing group. Thousands of the strongest and most vigorous young men left the coalfields during the inter-war depression and thousands more joined the Forces or went off to munitions when the fall of France closed the North European ports and led to temporary slackness in many South Wales collieries. The age composition of the mining community is badly distorted in consequence, and very heavily weighted on the side of age. One would expect a considerable amount of absenteeism on health grounds alone. But it is universally agreed by those who have a right to speak that at least half of the large number of absentees stay away from choice and not from necessity. Nor is this the only trouble, for even when they are at work an appreciable proportion of the men do not work at as quick a pace as they could without the risk of exhaustion. Indeed, some of the greatest authorities on the industry have stated that the whole of the coal output we need, both for home use and for export, could be obtained without any further recruitment into the industry if the present labour force were working at a reasonable pace.

No effort has been spared to induce miners to work harder and with greater regularity: exhortation and cajolery, bonuses on output, appeals to patriotism. National Coal Board conferences and summer schools have all been tried, but so far without success. Output fluctuates round about the same low mean and absenteeism remains obstinately high. The latest attempt to deal with the situation was the proposal made by the Joint Output Committee, backed by the National Coal Board and the executive of the National Union of Mineworkers, to set up joint attendance committees at every colliery with power to fine persistent offenders, but the majority of the area councils of the National Union of Mineworkers have refused to endorse it. The men have argued that it is not fair to saddle union officials with the responsibility for maintaining discipline which should be the job of the management, and, possibly, union officials are not too eager to have to undertake functions which might make them unpopular with the men who elect them. The executive of the National Union of Mineworkers has decided to invite all districts to submit alternative proposals for dealing with the problem, and these will be considered by the union and the Coal Board.

The miners' stonewall tactics have caused a general feeling of irritation in the country and, as it seems unlikely that any very constructive suggestions will be made in response to the union's invitation, the situation seems to be an impasse. But if one can get over the feeling of irritation one has to admit that there is a good deal to be said for the miner's attitude. His earnings have risen very considerably, much more than those of the majority of wage-earners. The rise in men's earnings over the whole of the coalfields is 118 per cent over pre-war, and for underground workers alone it is very much more than this. But what can he do with his higher income? He cannot move into a better house because there are not any available; household linens and curtains are limited by coupons and so are clothes; he cannot buy a small car or motorcycle and, even if he could get one, the smallness of the petrol ration is too great a deterrent to such heavy capital expenditure. The recreational facilities of his neighbourhood are usually limited to the cinema, the pub, and the Miners' Institute, and he does not need extra money to take advantage of these. And if he looks to the future and decides to earn more and save, he is discouraged when he realises on pay-day how much of his hoped for extra has been taken by Sir Stafford Cripps through P.A.Y.E. Is it not natural that he should be inclined to put a free day pretty high in his scale of values, even if the pleasure he gets is nothing more than freedom from the darkness underground or from the routine of an ordinary working day? How many business executives, whose work is done in much more agreeable conditions than those of the miner, could honestly say that they never take a day off for a game of golf or spend longer over lunch than is strictly necessary?

Individual Interest and Social Obligation

But to sympathise with the miner's attitude is not the same as to justify it. The trouble is, of course, that all of us who are now adult were brought up in a world whose assumptions and values were different in many ways from those which form the basis of our contemporary social organisation and it is much easier to alter administrative machinery than to change our ideas and reactions. In the social philosophy of thirty or forty years ago it was accepted as right and proper that you worked for yourself and for those near and dear to you, and for the good of the community only in a more general and indirect way. Society has always imposed certain legal duties upon us, such as the proper maintenance of a wife and children, and social custom has usually added further less well-defined obligations. But beyond that, it was not thought ignoble, or failing in one's civic duties, to choose increased leisure in place of greater material wealth. There has, in fact, been a certain amount of social disapprobation for the money-grubber who kept his nose too closely to the grindstone. But whether one chose hard work and more wealth or more moderate work and the easier life, it was considered a purely individual matter, so long as one's family obligations were properly met. That freedom of choice is no longer open to us. By a series of Acts, culminating in the great body of social legislation which came into operation last July, we have committed ourselves to providing for the whole community a degree of social security far beyond anything conceived by any other country and in so doing we have fundamentally changed the relationship of the individual to the community. By the National Insurance Act, the Industrial Injuries Act, the National Assistance Act, the National Health Service Act, the Children Act, and many others, we have set ourselves to guarantee to every member of the community a basic standard of living and certain basic services, irrespective of his own earnings. So far the whole emphasis of this tremendous act of faith has been laid on the benefits we are to receive, but the guarantee is worthless unless the country produces the real wealth that it has committed itself to distribute. It is the problem of realising what this involves that is the difficulty with which we are now faced. Men can choose leisure rather than wealth if they are content to endure insecurity and poverty. But if they decide that it is the responsibility of the State to provide its citizens with a secure living they automatically lay upon themselves the duty of producing the wealth which is the sole source from which such provision can be drawn. Unhappily, this corollary has not yet struck the imagination of the majority of the population and it is not too much to say that the full realisation of all that it implies is the most urgent need of contemporary society.

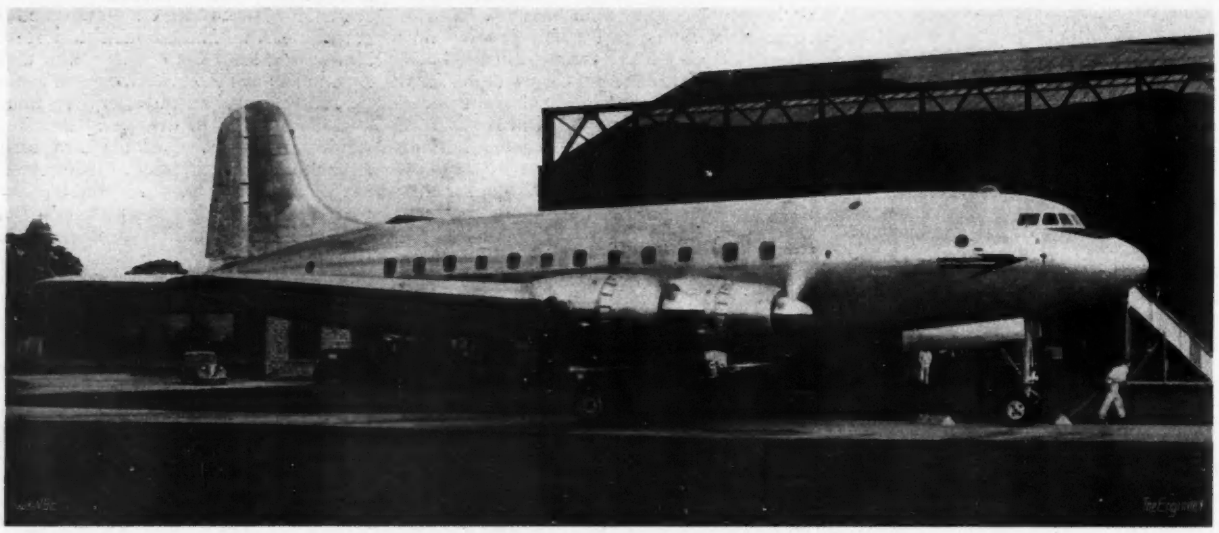
Aeronautics in 1948

FOR the British aircraft industry, 1948 was a year of much activity, and the main aeronautical event of the year, the Society of British Aircraft Constructors' flying display, held for the first time at the Royal Aircraft Establishment, Farnborough, in September, provided evidence of the quality of the post-war group of British aircraft now beginning to fly.

Few new large aircraft went into service during the year. As a consequence, the three State civil airline corporations were still in difficulties and produced poor operating results, a factor leading in part at least to the big losses the taxpayer is called upon to face. But it is now to be hoped that some of the new types will come into service shortly and that the picture may change. British Overseas Airways is soon to start receiving the big and luxurious Handley Page "Hermes IV"; British European Airways the Airspeed "Ambassador," by all accounts a first-rate machine for its job, and British South American Airways will complete its fleet of "Tudor IV" aircraft.

On the military side little information is available, but it may be assumed, we feel sure, that good progress is being made. A naval and military version of a new Hawker fighter, referred to later in this article, made its appearance. Some concern has been felt at the obvious gap in the bomber aircraft supply to the R.A.F., which has for some years depended on the Avro "Lincoln" in one form or another. The "Lincoln" is a magnificent machine, but is now outclassed by the modern bomber conception. Here again the fears expressed are no doubt groundless, for it was made known in November that jet bombers

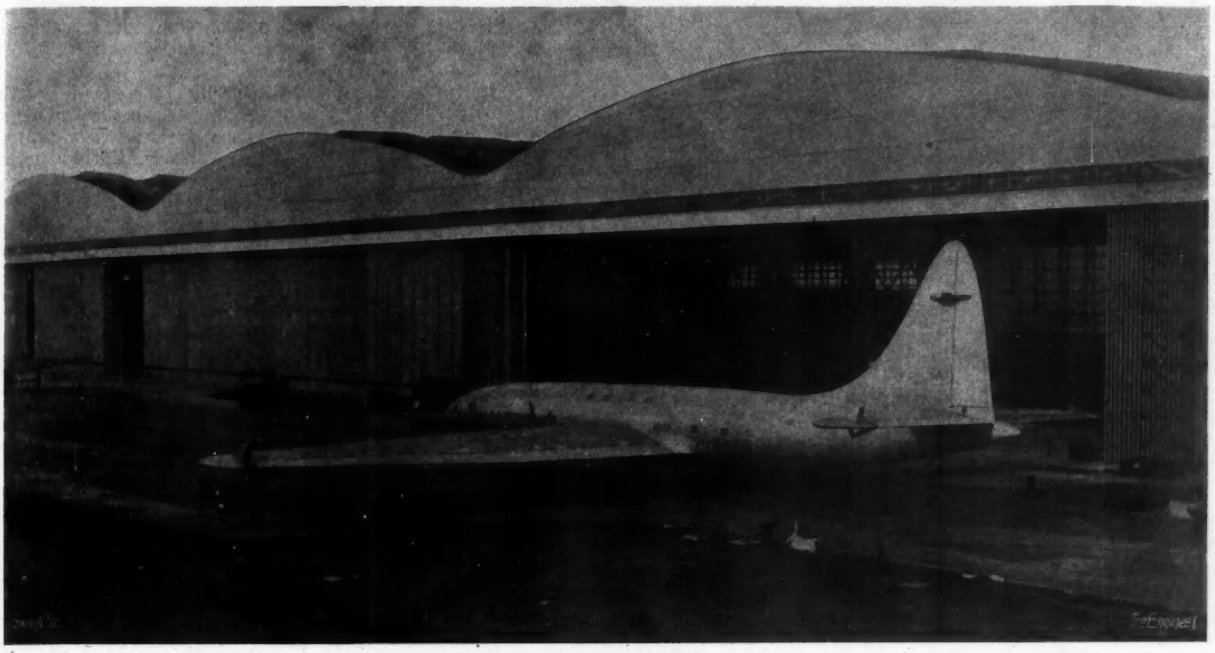
SOME CIVIL AIRCRAFT OF 1948



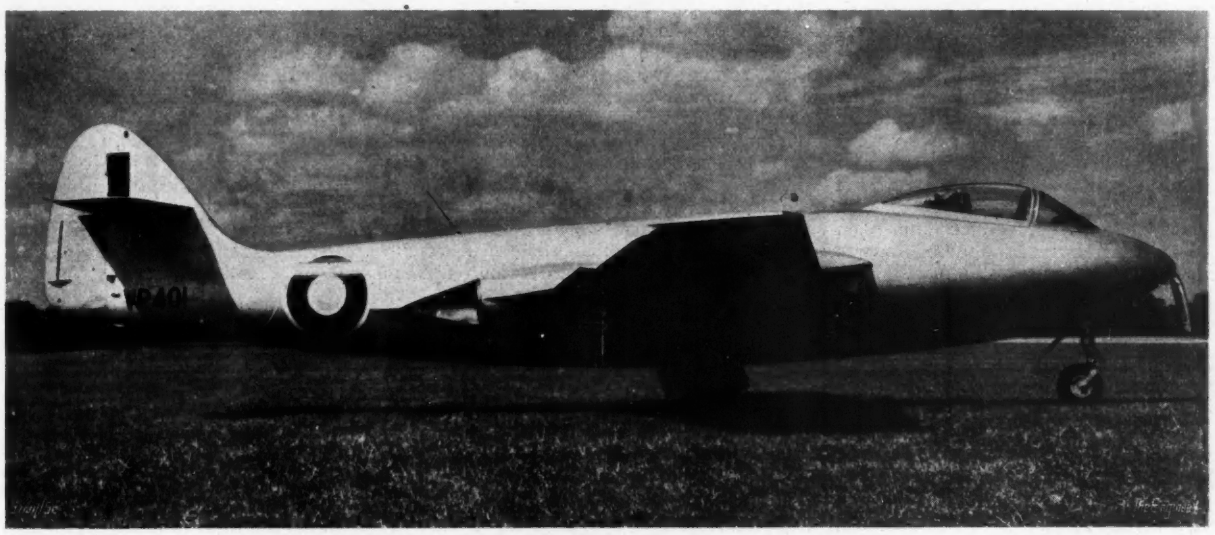
AVRO "TUDOR VIII" EXPERIMENTAL JET AIRLINER
HANDLEY-PAGE "HERMES IV" AIRLINER
VICKERS "VISCOUNT" PROPELLER-TURBINE AIRLINER

twice as fast as the "Lincoln" (top speed 314 m.p.h.) were under development by the Ministry of Supply and that the production line for at least one type of jet bomber had been laid down.

The very great changes taking place in aircraft, both military and civil, are, of course, due to the gas turbine engine in jet and propeller jet form. The year 1948 showed a significant increase in the actual use of such power plants in flight, though at present they have not been seen in civil aircraft except the Vickers "Viscount." Out of some sixty aircraft at the S.B.A.C. show, about twenty were powered by turbo-jet or turbo-propeller engines. The year was also notable for a convincing demonstration of the high standard of reliability and the small amount of maintenance required by these engines, for at Ministry of Supply request, the Bristol "Theseus" turbo-propeller engine, the de Havilland "Goblin II" jet unit, and the Armstrong-Siddeley "Mamba" airscrew-turbine all emerged with success from gruelling 500-hour tests. Yet there is need for caution in envisaging early operational use of such power plants in civil aircraft, for there are many problems still requiring solution, notably either a considerable improvement in fuel economy, or some solution to the difficulty of ensuring a landing being made within a reasonable time of the aircraft reaching its destination, and so avoiding "stacking" and circuiting for long periods at airports.



BRISTOL "BRABAZON I" OUTSIDE ASSEMBLY HALL



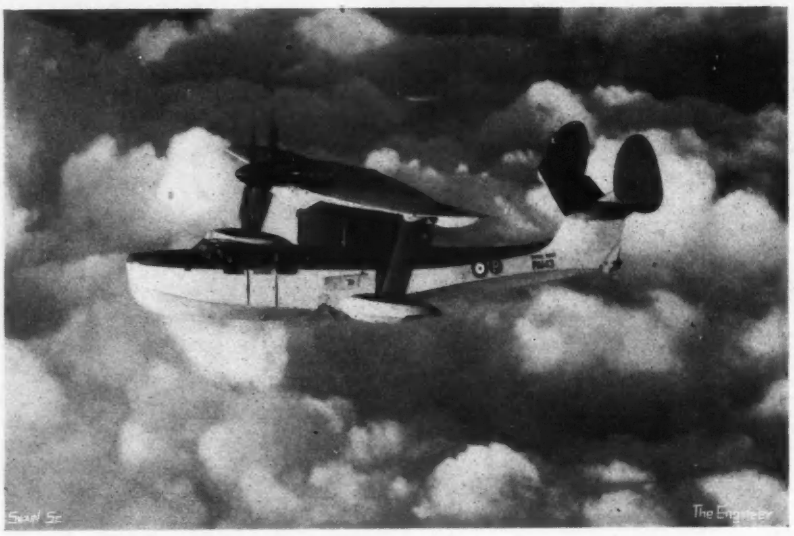
HAWKER "P. 1040" JET FIGHTER

While not, perhaps, of great technical significance, we feel that the magnificent feat of the Royal Air Force and all concerned in the maintenance of the Berlin air-lift cannot be left unrecorded. The first six months of the air-lift was completed on December 26th, and in the last twenty-four hours of that period 705 British and American aircraft came in at the three Berlin airfields, with 6100 metric tons of supplies. These aircraft were landed at the rate of one every three minutes. In all, 96,640 flights were made, carrying more than 700,000 tons of food, coal, raw materials and manufactures. This is an average of 3800 tons a day for the six months. The acute problem is still coal for Berlin's industry, which is only working at low capacity, but it is thought that, big though the figures are, for the daily supplies sent in, they can be further increased if required.

Civil Aircraft

In any review of civil aircraft progress, if only because of its great size and cost, pride of place must be given to the Bristol "Brabazon." This machine weighs 127 tons, has a span of 230ft, and in all is estimated to cost £11,580,000 before going into production. It seems an enormous sum for

one type of aircraft but, in fact, is made up of £5,950,000 for the estimated cost of two prototypes, including engines, and for the development and manufacture of special equipment, whilst a similar sum, £5,650,000, is the estimate for works services at Filton, Bristol. Such figures indicate conclusively that only by State financial backing can any manufacturer in future produce a new large aircraft. Big production runs to spread the development cost can hardly be hoped for, and all the world over it is now found that passenger fares cannot in general be made sufficiently high to cover airline operation, so that whether the world in its present state can truly afford subsidised air travel is a moot point. Evidently other considerations are paramount, otherwise there would be no new large aircraft under construction.



VICKERS-SUPERMARINE "SEAGULL" EXPERIMENTAL AMPHIBIAN

To return to the "Brabazon." Good progress has been made with the first prototype, which is now structurally complete. One of the Supplement pages shows the stage reached at the end of last October. The eight "Centaurus" engines, coupled in pairs to four sets of contra-rotating propellers, have been installed. An illustration herewith, reproduced from a photograph taken a few weeks ago, gives a good impression of the immense aircraft, standing outside its no less immense assembly hall. It is perhaps difficult to realise from these views that the installed power amounts to 20,000 h.p., so slender seem the propellers, yet they are 16ft in diameter. The aircraft is designed to carry 100 passengers non-stop between London and New York, for which a still-air range of 5500 miles is necessary. The Bristol Aeroplane Company is justly proud of the result of a rigid policy of structure weight control, for the actual weight of the structure has turned out to be 50 lb more than the estimate—a variation of only 0·025 per cent.

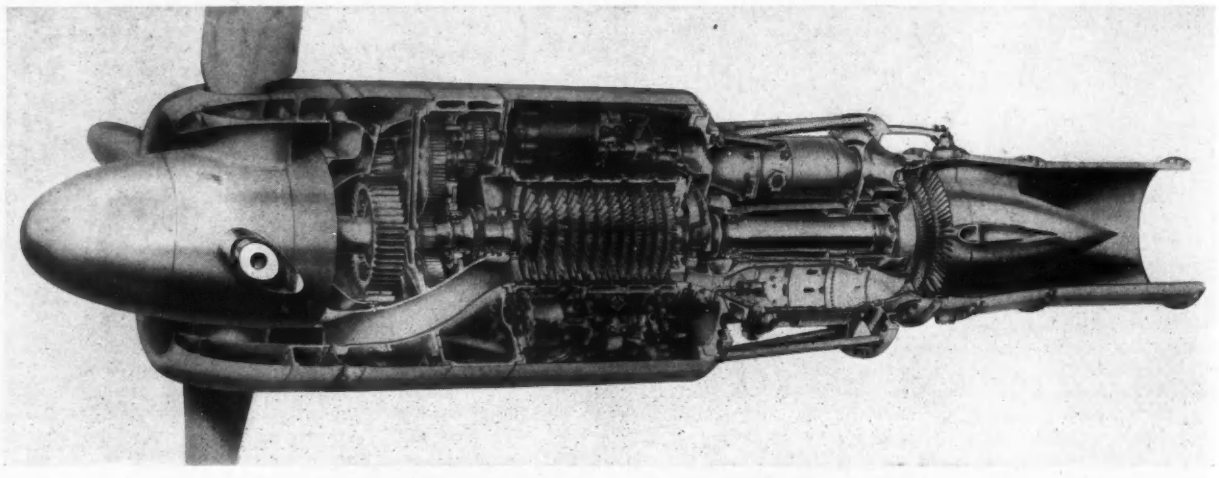
The latest report is that the "Brabazon I" should be ready for flight trials this spring. Meanwhile, work is going ahead on the building of the second prototype, which is to have "Proteus" propeller-turbine engines and is regarded as the production prototype.

Work on the companion large aircraft, the Saunders-Roe "S.R.45" flying-boats, is not so far advanced. Three of these aircraft are under construction at Cowes and our Supplement illustration shows the most advanced of the three hulls. This flying-boat, by far the largest ever to be undertaken by the British aircraft industry, is scheduled for trial flights in 1951. Its gross weight will be about 140 tons, and its span 220ft, only 10ft less than the "Brabazon." Ten "Proteus" propeller-turbine engines will give an aggregate power of 35,000 h.p. They will be partly buried in the wings in six assemblies, of which the two outboard will each have one engine unit driving a single propeller, the remaining four assemblies comprising pairs of engines geared together to drive contra-rotating propellers, similarly to the "Brabazon" arrangement. The hull is of figure-eight or "double-bubble" construction, fully pressurised, and promises great comfort on two decks for 100–140 passengers and crew.

At one time during the year it was feared that the "S.R.45" project would be abandoned, but the Government evidently made up its mind to go ahead with these promising aircraft, for it was announced that support would be given to British South American Airways' plans for long-range services with the "S.R.45," of which they are eventually to have seven.

One of the more interesting civil aircraft flown for the first time during the year, was the Vickers "Viscount," the first four-engined, propeller-turbine air liner ever to have taken the air. A few weeks ago press correspondents were permitted to fly in this machine, and they were agreed that the absence of vibration and noise within the fuselage heralded an altogether new standard of comfort. The "Viscount," illustrated herewith, has four Rolls-Royce "Dart" propeller-turbine engines, but has been designed for the alternative fitting of the more powerful Napier "Naiad" or Armstrong-Siddeley "Mamba" propeller-turbine units. Designed as a replacement for the "Viking" on the short-range European routes, the "Viscount" is claimed to have met the specification in all respects. It is understood, however, that no production machines of this type have been ordered and the Airspeed "Ambassador," described in last year's review, is to be the "Viking" replacement.

Most of the new civil aircraft were flown at the Society of British Aircraft Constructors' display, held last year for the first time at Farnborough aerodrome. Our issues of September 10th, 17th and 24th included a report on the "Viscount" air liner and of the display. Much interest was shown in the experimental "Tudor VIII," which is said to be the first four-engined jet air liner to fly. This machine has four Rolls-Royce "Nene" jet engines, arranged in pairs, and its purpose is to further the development of the high-speed jet air liners now projected. It is understood that the machine has a service ceiling of 44,000ft. Its appearance is shown in one



ARRANGEMENT OF NAPIER "NAIAD" TURBO-PROPELLER ENGINE

of our illustrations. The Handley Page "Hermes IV" was also flown at Farnborough. The largest British air liner now flying, the "Hermes IV" has a top speed of 357 m.p.h., with four Bristol "Hercules" engines, and is designed for up to sixty-three passengers. It is a luxurious aircraft, with steerable nose-wheel undercarriage, and a high angle of incidence gives the high lift for which the wing is designed.

Military Aircraft

As already mentioned, few new military aircraft were shown during the year. The new fighter of the year was the Hawker "P.1040," which we illustrate above. This machine is still on the restricted list for publication of technical details. It is an extremely fast and manœuvrable military fighter and has also appeared under the type designation "N.7/46," as a naval fighter, with de k landing gear. It is propelled by a Rolls-Royce "Nene" engine, with wing-root air-intakes and bifurcated jet outlets, each trunk discharging to the rear of the wing trailing edges along the fuselage.

CIERVA "AIR HORSE" HELICOPTER

fully pressurised fuselage. Delivery of twenty-five of these machines for service on B.O.A.C.'s Empire routes is to begin shortly.

Amphibian Aircraft

One of the notable amphibian aircraft of the year was the Vickers-Supermarine "Seagull," illustrated above, designed to an Air Ministry specification to succeed the well-known "Walrus" and "Sea Otter." It has a Rolls-Royce "Griffon" engine, driving contra-rotating propellers, giving a maximum speed of 260 m.p.h. at 11,800ft. The tail wheel and undercarriage are hydraulically retractable. When operating only on water the undercarriage can be quickly detached. However, the most interesting point about the machine is a variable incidence wing, with inter-connected, full-span, leading-edge slots and slotted flaps. The equipment permits the wing to be set at the best angle for take-off, whilst in level flight the incidence can be adjusted to reduce the hull drag to a minimum. When landing,

Rotating-Wing Aircraft

An interesting newcomer to the ranks of British helicopters and rotating-wing aircraft which have flown was the three-rotor Cierva "Air Horse," which made its first flight recently at Southampton airport. It has its three rotors driven by a Rolls-Royce "Merlin," 1640 h.p. piston engine, and is designed to carry about three tons, thus being the largest and most powerful British helicopter yet built. Our illustration shows the machine as it appeared at the S.B.A.C. display.

Shipbuilding and Marine Engineering in 1948

No. II—(*Continued from page 24, January 7th*)

IN our last article we dealt with the position of the shipbuilding and marine industry in 1948 and its future, and mentioned the research work done and now going on. Some of the principal liners of 1948 were illustrated and described. Most of these ships are propelled by geared steam turbine machinery. We now pass to some of the motor ships completed during 1948, wnich included passenger and cargo liners, oil tankers and cross-channel ships. One of the largest motor passenger liners was the "Caledonia," constructed and engined by the Fairfield Shipbuilding and Engineering Company, Ltd., of Govan, Glasgow, for the Anchor Line's service between Liverpool, Karachi and Bombay. She has a gross registered tonnage of 11,315 and her principal dimensions include overall length 506ft, beam 66ft, and depth to the upper deck 35ft 6in, with a loaded draught of 27ft 6in. The "Caledonia" is larger than the earlier ships in the same service, the "Circassia" and "Cilicia," and is designed to carry 304 one-class passengers, for which excellent provision, both as regards public rooms and cabin accommodation, has been made.

The propelling machinery, which is designed for a normal speed of 16½ knots, comprises a twin-screw arrangement of Fairfield-Doxford four-cylinder opposed-piston engines. The cylinder diameter is 725mm, with a combined stroke of 2250mm and the normal continuous rating for the engines is 5100 s.h.p. at 115 r.p.m., with a maximum trial trip output of 5700 s.n.p. at 150 r.p.m. The engines can exhaust into a Cochran composite boiler, or direct to the funnel. The electrical equipment includes three Ruston and Hornsby 320-kW oil engine-driven generator sets.

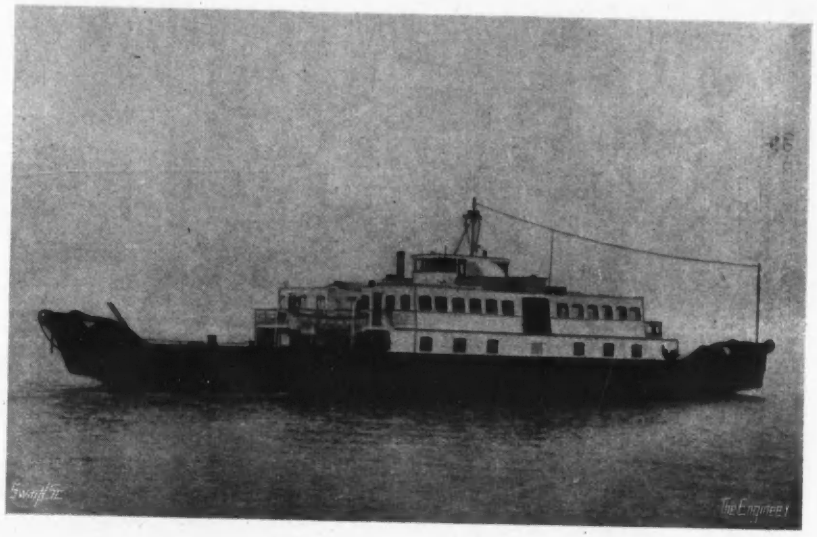
Cross-Channel Ships

One of the first cross-channel motor ships to be commissioned in the period under review was the "Munster," built and engined by Harland and Wolff, Ltd., at Belfast, for the British and Irish Steam Packet Company (Coast Lines, Ltd.,) which saw service on the Cork-Fishguard run, prior to taking her place with a sister ship, the "Leinster," on the Dublin-Liverpool service. A view of the "Munster" is given on page 60. She is a motor vessel, having a length of 367ft overall, a breadth moulded of 50ft, and a depth moulded to the main deck of 19ft. Her gross registered tonnage is about 4000. She is designed to carry 225 first-class passengers and 107 third-class passengers. Single-berth and two-berth cabins and dormitory accommodation is provided, and the public rooms include dining and smoking rooms, with a lounge and drawing room. Arrangements make provision for carrying on this ship as many as 484 head of cattle on the main deck forward, and the lower deck, both forward and aft. A Lux-Rich fire-detecting and a Grinnell automatic sprinkler extinguishing system is fitted, while thermo-tank units ensure good ventilation.

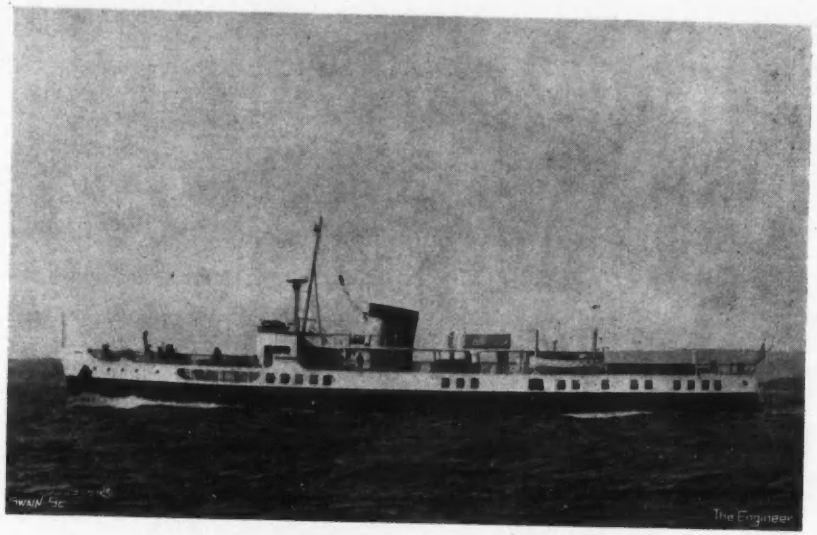
The propelling machinery comprises a twin-screw arrangement of ten-cylinder Harland B. and W. two-stroke trunk-piston engines, with a total designed output of 5600 s.h.p. They each have cylinders with a bore of 500mm and a piston-stroke of 900mm, and the normal running speed is 130 r.p.m., corresponding to a ship's speed of 18 knots. The rotary blowers are engine driven through gearing from the crankshaft. The exhaust gases pass through a Clarkson boiler, which is equipped with an auxiliary oil-burner, giving a capacity of 4000 lb of steam at 80 lb per square inch. Current is supplied by four Harland and Wolff generating sets, and each set has a rating of 150kW and runs at 450 r.p.m. A complete range of pumps for all services is provided, and ejectors are utilised to eject the sludge from the cattle-carrying decks.

Another interesting ship of the year was the diesel-electric car ferry "Farringford," which was constructed by William Denny and Brothers, Ltd., of Dumbarton, for the British Railways, Southern Region, ferry service between Lymington, Hants, and Yarmouth, in the Isle of Wight. That service, during the war, was maintained by the "Lymington," which was one of the first ships in this country to be equipped with Voith-Schneider propulsion. The "Farringford" is a larger ship than her predecessor, and she has a length of 178ft and a beam of 49ft 6in, with a measurement of 489 gross tons. As our illustration reproduced on page 60 shows, she is a double-ended vessel provided with hinged gangways to enable her to embark and disembark vehicles. The height of the wheel house is such that a double-decker omnibus could pass beneath the bridge. Saloons and buffet-

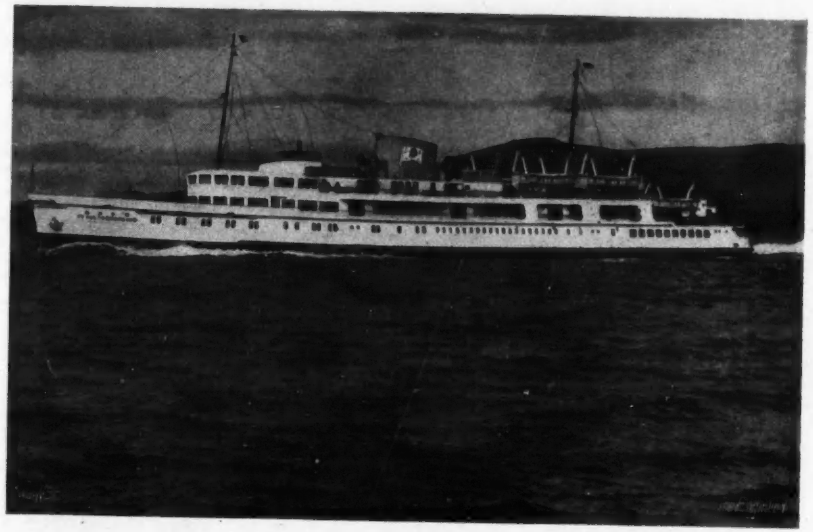
SOME SMALLER SHIPS OF 1948

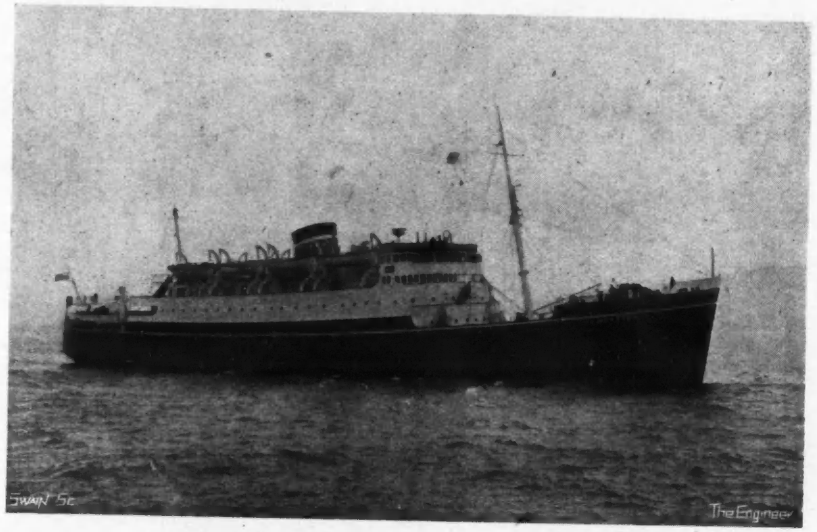


DIESEL ELECTRIC CAR FERRY "FARRINGFORD"
M.V. "ROYAL SOVEREIGN"



ISLE OF WIGHT MOTORSHIP "SOUTHSEA"
IRISH CHANNEL MOTORSHIP "MUNSTER"





bars on each side of the ship are provided.

The propelling machinery was divided between the shipbuilders and the English Electric Company, Ltd. The shipbuilders built the two paddle wheels and the feathering gear, and provided the chain drive between the driving motors and the paddle shafts, while the twin generating sets, the propelling motors and the bridge-control system and switchgear were constructed and installed by the English Electric Company, Ltd. Each engine has six cylinders, with a bore of 10in and a stroke of 12in, and operates on the single-acting, four-stroke principle, having a designed output in normal service of 420 b.h.p. when running at 650 r.p.m. When necessary, the power can be increased to 500 b.h.p. at 700 r.p.m. Each of the two main generators has an output of 225kW, with 285kW at the two speeds just named. The circuit is so arranged that if required each engine can drive both paddles, which run at 40 r.p.m. The propelling motors each have a designed output of 275 b.h.p. at 240 r.p.m. Both the propulsion motors and the generators are excited from the ship's 220-V d.c. auxiliary circuit, which is supplied by two 60-kW generators, chain driven from the main propulsion generating sets. A Gardner-Lancashire dynamo 60-kW oil engine generator set is used as a standby. The "Farringford" showed good reversing and manœuvring capabilities, which have proved valuable in navigating the somewhat narrow and shallow waters of the Lymington River.

A cross-channel ship which entered the Thames River service during the summer and will doubtless be used for Continental trips when circumstances allow, was the "Royal Sovereign." She was Denny built and engined and we show a view of her taken during her trials on the River Clyde on page 60. Her overall length is 285ft, with a moulded breadth of 48ft, an extreme breadth of 50ft 10in, and a measurement of about 1850 gross tons. The "Royal Sovereign" is of modern design, with a covered observation lounge on the sun deck in addition to the spacious lounge on the promenade deck. On the main deck are two dining rooms and other buffet bars in the sun deck lounge. Provision is made for carrying 1783 passengers.

The propelling machinery comprises two twelve-cylinder Denny-Sulzer engines, each of which has a designed output of 2250 s.h.p. The current for power and lighting is derived from three Allen oil engine-driven generating sets, each of 100-kW capacity. All the deck and auxiliary machinery is electrically operated.

Towards the end of 1948 two further motor ships entered the Isle of Wight service of British Railways, Southern Region. They were the "Southsea" and the "Brading," designed and engined by William Denny and Brothers, Ltd. They each have a length of 200ft with a breadth moulded of 46ft and a draught of 7ft, their measurement being about 837 gross tons. Each ship has accommodation for 1400 passengers with officers and a crew numbering thirty-three.

The propelling machinery consists of a twin-screw installation of Sulzer eight-cylinder, two-stroke trunk-piston engines, each having a designed output of 950 b.h.p., which drive the propellers through oil-operated S.L.M. gearboxes, enabling the ship to be rapidly manœuvred ahead or astern without reversing the main engines. Power and lighting for the engine-room and deck auxiliaries is provided by three Ruston and Hornsby 60-kW oil engine-driven generator sets, while steam for domestic services is raised in a Cochran boiler fired with oil fuel on the Clyde system.

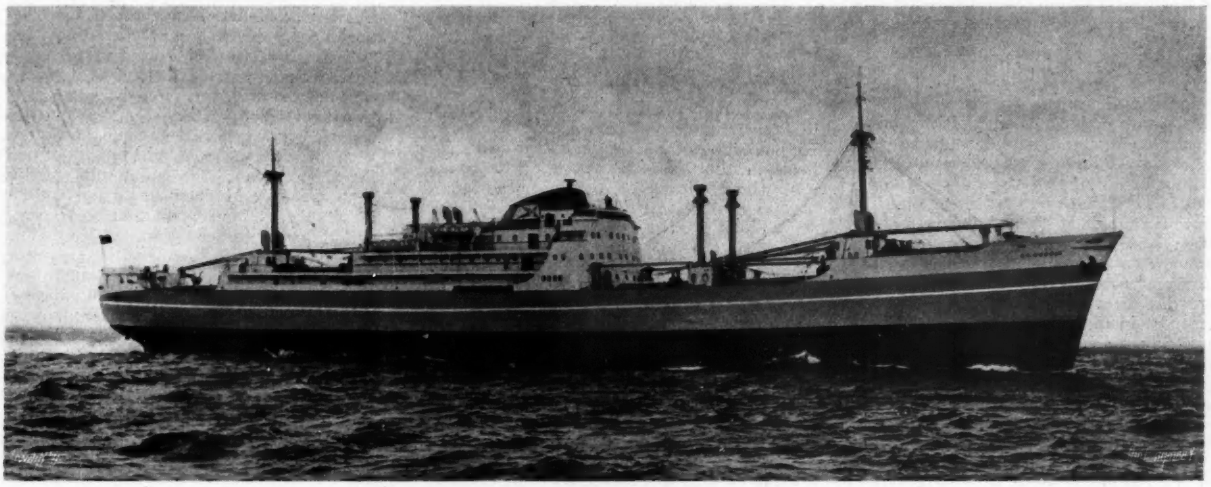
These new vessels incorporate twin rudders operated by electro-hydraulic steering gear, and a welcome aid to navigation is the provision of Cossor radar apparatus, in addition to standard navigation equipment. The appearance of the ships is pleasing, and the raked stem and cruiser stern, combined with the short streamlined funnel and tripod mast, are new features among ships engaged in Solent passenger traffic.

Two Motor Cargo and Passenger Ships

Among the motor cargo ships completed in 1948, the single-screw motor cargo and passenger vessels "St. Essylt" and "St. Thomas," which were constructed by Joseph Thompson and Sons, Ltd., of Sunderland, and engined by William Doxford and Sons for the South American Saint Line, Ltd., of Cardiff, deserve special mention. There is no doubt that these two ships will be welcomed in the South American trade. Their modern design was worked out jointly by Mr. J. E. Church, the marine superintendent of the Saint Line, and Mr. R. Cyril Thompson, C.B.E., the managing director of the shipbuilders. Their appearance, with the combined three-tier raked superstructure amidships surmounted by a streamlined funnel, strikes a new note in cargo-ship construction. The soft-nosed bow is curved upwards and a cruiser stern is adopted. Excellent provision is made for carrying twelve passengers and the crew accommodation follows the lines laid down by Mr. Church in his recent Institution of Naval Architects paper. The principal dimensions of each ship are as follows: length overall 472ft 4½in, breadth moulded 59ft 4in, depth to upper deck 39ft 8in, and measurement 6855 gross tons. There are five holds, each served with derricks and electric winches, and the deadweight carrying capacity of each ship is 14,372 tons, including provision for 632,862 cubic feet of grain and 568,541 cubic feet of bale cargo.

The designed output of the machinery is 5300 s.h.p. at 114 r.p.m. The engine is a five-cylinder Doxford opposed-piston unit, having a cylinder bore of 670mm and a combined stroke of 2320mm. In this engine the controls are conveniently arranged at the end of the engine, instead of at the more usual centre position. For supplying the large electrical load there are three National oil engine-driven generator sets of 175-kW capacity each, and one 85-kW Belliss and Morcom steam engine-driven generator. Steam is raised in a cylindrical boiler with three furnaces, the wing furnaces being oil-fired and centre furnace designed to use oil fuel or utilise the heat from the exhaust gases.

(To be continued)



Single-Screw Cargo and Passenger Motorship "St. Essylt"

"Whites of Cowes, Shipbuilders."—In our issue of January 30, 1948, we recorded the fact that J. Samuel White and Co., Ltd., of Cowes, celebrated its jubilee as a limited company. When in 1898 the business of John Samuel White was converted into a public company, the firm had, as a private concern, already been in existence for some 150 years. As might well be expected, the history of the firm during the 200 years it has been connected with shipbuilding industry is of absorbing interest. To put a full and detailed account of its growth and achievements on record would be a work of considerable magnitude, but, in a handsome and beautifully produced little volume entitled "Whites of Cowes, Shipbuilders," the firm has now presented the outstanding landmarks of its long and colourful history. All who are concerned with ships and shipbuilding will certainly wish to read this interesting book about such an old-established and well-known company.

Industrial and Labour Notes

The Engineering Industry and the Budget

The Engineering Industries Association has recently made representations to the Chancellor of the Exchequer in relation to the 1949 Budget. Among the points put forward for consideration are the removal of controls, the pruning of clerical staffs in Government offices, and a reduction in the standard rate of income tax. Reference is made to the statement by the Anglo-American Council on Productivity that the principal need of British industry is a greater degree of efficient mechanisation, which, the Association suggests, could be achieved by applying any available surplus to reducing the burden of taxation on industrial profits, so that industry could spend more on mechanisation.

Whilst the Engineering Industries Association expresses agreement with the policy of budgeting for a surplus, it considers that in the next fiscal year some part of any anticipated surplus should be used to grant relief from taxation. Such relief, it is felt, might well be augmented if greater efforts were made to reduce national expenditure, and the Association contends that, although there has been a certain amount of investigation with a view to the removal of controls, there still remains considerable work to be done in that direction. Furthermore, it is maintained that many Government departments continue to employ manpower out of all proportion to the tangible benefits to the national economy resulting from their work.

The Association is of the opinion that any available surplus should be applied in reducing the burden of taxation on industrial profits so that industry could utilise a more appropriate proportion of those profits to replace its assets. The more efficient mechanisation advocated by the Anglo-American Council on Productivity could be encouraged, it is suggested, through correct handling of taxation policy. A reduction in the standard rate of income tax would, to some extent, achieve the desired purpose, but the Association thinks also that some additional reliefs are essential for the maintenance of productivity.

Coal Production

The saleable output of deep-mined coal in Great Britain during 1948 reached a total of 196,689,200 tons, and was therefore 98·34 per cent of the target figure of 200,000,000 tons set early in the year. The year's production from opencast workings amounted to 11,729,300 tons and thus exceeded the target which was put at 11,000,000 tons. In the year 1947—which, for statistical purposes comprised 53 weeks—total coal production was 196,745,500 tons, a figure which was exceeded by 11,673,000 tons in the year which has just ended.

In the final week of 1948 the output of deep-mined coal dropped to 2,498,400 tons and that of opencast coal to 89,700 tons. The Ministry estimates that recognised holidays, disputes and breakdowns, during that week caused a loss of 1,152,400 tons of deep-mined coal, but that figure does not take into account the amount lost through absenteeism. Voluntary absenteeism amongst face workers in the week ended December 25, 1948, was 7·72 per cent and over fifty-one weeks ended December 25th was 7·58 per cent, compared with 8·08 per cent in the corresponding period of 1947. Output per manshift during 1948 was, for face workers, approximately 2·92 tons, compared with 2·86 tons in the preceding year. The weekly average number of face workers on colliery books in 1948 was 292,700, as against 288,100 in 1947.

Speaking in London on Monday last, Lord Hyndley, chairman of the National Coal Board, said it was hoped that production of deep-mined coal in 1949 would be between 210,000,000 tons and 215,000,000 tons. The manpower target for the end of 1949 was 736,000, which would mean an increase of about 10,000. The extension of working hours and the extra Saturday shift during 1948, Lord Hyndley observed, had produced an additional 7,123,000 tons, but had proved to be an expensive undertaking. The Coal Board's profits for the year just ended would, he thought, be appreciably less than the £5,000,000 which had been forecast in some quarters. Finally, Lord Hyndley announced that the Board had set up a committee which would tour the divisions to see what could be done to increase output and decrease costs. Mr. T. E. B. Young, production member of the Board, is the chairman of the committee, the other members being Mr. L. H. Lowe, finance member, Mr. E. Edwards, labour relations member, and Mr. J. Latham, director-general of finance.

Railway Wages

At the end of last week the Ministry of Labour made a statement on the procedure to be adopted for dealing with the dispute between the National Union of Railwaymen and the Railway Executive, the London Transport Executive, the Docks and Inland Waterways Executive, and the Hotels Executive, over the question of a wages claim. It will be recalled that a claim put forward by the N.U.R. for an increase of 12s. 6d. a week was rejected by the four Executives, and that, after discussing the rejection, a delegate conference of the union decided to inform the Minister of Labour of the existence of a dispute.

The Ministry's statement said that the Executives had confirmed that a dispute existed and also referred to the Conditions of Employment and National Arbitration Order, 1940. It had been decided, the statement continued, that so far as the dispute with the Railway Executive and the London Transport Executive was concerned, the Minister of Labour would seek advice from the National Arbitration Tribunal as to whether existing joint machinery available in each case provided suitable means for settlement. The dispute affecting the Docks and Inland Waterways Executive, it was explained, would be dealt with by the Minister in the light of the advice received from the National Arbitration Tribunal. The statement added that as no machinery existed at present for the settlement of the dispute with the Hotels Executive, this matter had been referred to the National Arbitration Tribunal for settlement under the Order.

The Regional Boards for Industry

When it was decided at the end of the war to continue the Regional Boards for Industry, it was arranged that they should operate under part-time chairmen appointed by the Chancellor of the Exchequer. The appointments were for a period of three years, which has now expired, and the Chancellor has consequently made some reappointments and filled vacancies which have arisen through retirements.

The function of the Boards is a purely advisory one, which, it is claimed, has proved of great value in the field of co-operation between employers and workers. The chairmen who have now been appointed for a period of three years, are : Northern, Sir Mark Hodgson, in place of Viscount Ridley ; East and West Ridings, Mr. G. H. Bagnall ; North Midland, Mr. S. F. Peshall ; Eastern, Mr. H. Weston Howard ; London and South-Eastern, Sir John Buchanan, in place of Sir Frederick Leggett ; South Western, Lieut.-Colonel Mark Whitwell ; Wales, Sir Percy Thomas ; Midlands, Mr. W. H. Stokes ; North Western, Major J. H. Mandleberg, and, Scotland, Bailie C. Murdoch. An appointment remains to be made in the Southern Region as Mr. C. N. Gallie is unable, for health reasons, to continue as chairman.

A Survey of Industrial Management

As the first of a series of "Occasional Papers," the British Institute has just published "A Short Survey of Industrial Management," by Mr. L. Urwick. It is hoped that this series of papers will make a useful contribution to management literature, but it is pointed out that, in expressing the personal opinions of their authors, they will not necessarily represent the official views of the Institute.

Mr. Urwick's survey is divided into five main sections, under the headings The Nature of Management, The Evolution of Scientific Management, The Mechanics of Management, The Dynamics of Management, and Looking Forward. He stresses throughout that it is no longer possible, even for the most extreme individualist, to fail to recognise that the business of Government and the government of business are, in fact, a single problem. The task of conducting economic institutions the survey says, has become so interwoven with and so dependent on the task of conducting the affairs of the community as a whole that waste and inefficiency anywhere lead inevitably to low production and consequent suffering everywhere.

Mr. Urwick also emphasises the enormous amount of work still to be done in the field of industrial management, and expresses the hope that more attention will be paid in the future in Great Britain to management principles. His final word includes a quotation from John Morley's "On Compromise," which suggests that men are thinking much of the interests of to-day, and little of the more ample interests of the many days to come.

Copies of the paper, price 2s. 6d., are obtainable from the British Institute of Management, 17, Hill Street, London, W.1.

Monopolies and Restrictive Practices Commission

The Board of Trade has announced the membership of the Monopolies and Restrictive Practices Commission as follows : Sir Archibald Carter, K.C.B. (chairman), Mr. C. N. Gallie, Mr. Frederick Grant, K.C., Mrs. Joan Robinson, Sir Harold Saunders, Mr. Gordon Stott, the Hon. Josiah Wedgwood, and Mr. R. E. Yeabsley. The Commission has been set up under the Monopolies and Restrictive Practices (Inquiry and Control) Act, 1948, the main purpose of which is to provide for the investigation of monopolies and restrictive arrangements in industry and trade, and to give the Government powers for dealing with those which are found to work against the public interest. It is stated that the Commission will not initiate inquiries but will investigate matters referred to it by the Board of Trade under the Act.

Engineering Unions and Productivity

The first of the sectional conferences on productivity, convened by the Trades Union Congress, was held in London on Friday last, when members of the T.U.C. General Council met the Executive Committee of the Confederation of Shipbuilding and Engineering Unions and the general secretaries of engineering unions. A statement said that the purpose of the conference was to consider ways and means of implementing the decisions—so far as the engineering industry was concerned—of the special conference of union executives held last November.

Among the matters discussed were the improvement of information services to trade union members, the training of shop stewards, the organisation of joint production committees, the early examination of "bottlenecks" and shortages, and the improvement of technical efficiency at the workshop level. These points, the T.U.C. statement ended, are to be further considered by the Confederation's executive when more detailed proposals will be examined.

French Engineering News

(From our French Correspondent)

Negotiations for the construction of a steel plant in France are at present going on between France and five American companies, according to a Westinghouse Electric Corporation spokesman. The construction will cost 40 million dollars, and will be financed from Marshall Aid funds. The five companies concerned are: The Bliss Manufacturing Company, the Continental Foundry and Machine Company, the Mesta Machinery Company, United Engineering and Foundry Company, and the Wean Engineering Company. Westinghouse will carry out the electric installations in the new plant. The French firm which is negotiating for the plant is Sollac, a new organisation constituted by nine French steel companies. The plans include construction of a 66in bloom mill, and a 66in hot rolling mill at Havauge. At Ebange, a 48.n cold rolling mill for tinplate will be installed.

* * *

According to a report on the extent to which the S.N.C.F. has fulfilled its scheme for modernisation and re-equipment, the most urgent of the reconstruction work has been completed, although the security margin is still slight and practically nil during peak traffic. Owing to the necessity to restrict investments, the S.N.C.F. programme for 1948 was extremely limited. During the first half of the year, Treasury advances amounted to about 27 milliard francs, but owing to delays in actual allocations S.N.C.F. investments amounted only to 20 milliard francs, of which 8 milliards were for rolling stock and 12 milliards for fixed installations. There is still a deficit in goods and passenger rolling stock, but the steam locomotive situation is fairly satisfactory.

* * *

Replying to questions in the National Assembly on the Ruhr Statute, the Minister of Foreign Affairs, Monsieur Robert Schuman, stated that France had never renounced her claims to German factories, although some had not been found suitable for French needs. Ruhr production, he stated, was still suffering from war destruction. In 1939, monthly coal production was over 11 million, whilst to-day it barely reached 8 million tons. Steel production was 1,750,000 tons a month in 1938, in January, 1948, was 313,000, and in October was 610,000 tons. France, he stated, was interested in the unlimited development of coal mining, but steel production, he thought, should be kept within production limits compatible with peaceful utilisation. In 1947, France received 700,000 tons of Ruhr coke, and in the first ten months of 1948, 1,800,000 tons. Total fuel received from the Ruhr in 1948 was expected to amount to 6 million tons, or treble the 1947 figure. Out of a production of 2 million tons, France had undertaken to deliver 335,000 tons of ore in eight months to Germany. In return she would receive 110,000 tons of ore more suitable for the French steel industry.

* * *

According to a plan drawn up for the Nord, electric plants in this region will increase their power from 285,000kW to 525,000kW at a cost of 8½ milliard francs. At Sequedin, output will increase from 40,000kW to 80,000kW, and the programme includes the installation of two boilers which will each supply steam to a 40,000-kW turbo-alternator. It is expected that the first boiler will start working at the beginning of 1949. A modern generating plant at Comines will include two 50,000-kW turbo-alternators connected with the national network. A 5000-kW house set will be installed. Special fuel-burning equipment will enable all qualities of coal to be used, and the station will possess its own coal-preparing plant. At Lourches, power will be increased from 35,000kW to 115,000kW, and it is expected that the first stage of this scheme will be completed by July, 1949. Finally, power at the Maubeuge station will be increased from 60,000kW to 80,000kW in 1950. While the supplementary power resulting from new equipment will finally go to the general network of Electricité de France, industries in the Nord, near to the stations, will benefit.

Notes and Memoranda

Rail and Road

SCOTTISH REGION REORGANISATION.—The Scottish Region of British Railways on January 1, 1949, was divided into seven commercial and operating districts and nine motive power districts. The organisation of signals and telecommunications provided for six areas, each under the charge of an area assistant. This reorganisation is designed to enable a closer link to be maintained between the public and the railway and between the departments.

PASSENGER TERMINAL AT SOUTHAMPTON DOCK.—The Southern Region of British Railways states that the general building contract for the new passenger terminal, Ocean Dock, Southampton, has been placed with Staverton Builders, Ltd., Totnes, Devon. The work comprises concrete floors and walls, roofing, joinery, glazing and painting, for a two-storey building, 1270ft by 120ft. The steel framework has already been erected by the Cargo Fleet Iron Company.

BRITISH TRANSPORT RECEIPTS.—The British Transport Commission has announced that in the four-week period ended December 26, 1948, traffic receipts of British Railways totalled £24,881,000. In the same period London Transport's traffic receipts amounted to £4,242,000, and the tolls and freight charges received by Inland Waterways totalled £143,000. In the fifty-two weeks of 1948, ended December 26th, the British Transport Commission's traffic receipts amounted in all to £391,583,000, the comparable figure for 1947 being £352,610,000. It is pointed out, however, that the figures represent gross receipts and do not reflect variations in expenditure which any estimate of net revenue must take into account. Moreover, the comparison of 1948 with 1947 is affected by increases in fares and other charges which were introduced at different dates in 1947 to meet estimated increases in operating costs.

Air and Water

THE CONGO RIVER.—It is stated that work will begin shortly on the widening of the mouth of the Congo River, to permit ships to steam up the river at night as far as Matadi. Hitherto, this part of the river has been navigable only in daylight. The construction of a floating dock at the river mouth is also planned.

PORTUGUESE PORT SURVEY.—A commission appointed by the Portuguese Ministry of Communications has recently completed a report on the condition of port and shipping installations. It is stated that the report suggests that port installations in Portugal are no longer in a condition to serve the needs of the country's increased merchant fleet.

RECONDITIONING OF SWEDISH ORE CARRIER.—A thorough reconditioning of the Swedish ore-carrying vessel "Oxelösund," has just been completed and she is now loading at Narvik, where she was scuttled by the Germans in April, 1940. After seven years at the bottom of the sea, the ship—which has been renamed "Laidaure"—was raised from a depth of 90ft and towed to Gotaverken, where the extensive overhaul was carried out.

EDINBURGH (TURNHOUSE) AIRPORT.—The Ministry of Civil Aviation has reached agreement with the British European Airways Corporation on the technical measures necessary to ensure regularity of air services all the year round at Turnhouse airport. The measures include certain navigational aids, some of which are already installed, and the rest of which will be ready before the normal reopening of the Turnhouse services this spring. As an extra precaution, a length of ground at the south-east end of the main instrument runway is to be consolidated so as to obviate any possible danger of an aircraft over-running in bad weather.

Miscellanea

LEAD SHEET AND PIPE.—Following upon an increase in the cost of lead, the Minister of Works has authorised an increase of £11 15s. per ton in the maximum selling prices of lead sheet and pipe. The increase applies to all sales made on and after January 1, 1949.

THE LATE MR. G. C. HIBBERT.—We have learned, with regret, of the death of Mr. Geoffrey C. Hibbert, which occurred on January 7th. Mr. Hibbert, who was forty-eight, had been associated for some time with E. H. Jones (Machine Tools), Ltd., and for the past three years had occupied the position of director and general manager of that company.

THE LATE MR. F. W. OGBORN.—We note, with regret, the death, on December 27th last, of Mr. F. W. Ogborn, London representative of Hattersley (Ormskirk), Ltd. He had been in the company's service for nearly forty years.

GOVERNMENT DEPARTMENT ELECTRICAL SPECIFICATIONS: G.D.E.S. 24: 1948, FOR CABLE DRUMS.—The Committee on the Standardisation of Electrical Cables and Wires for Government Services (Secretary, Ministry of Supply, I.E.M.E., Walsingham, Chislehurst, Kent) has recently issued a revised version of G.D.E.S. 24: 1948, for cable drums. The specification now includes a preferred list of drums in addition to a table of design details, and various other changes have been made in the text. Copies of the specification are obtainable from H.M. Stationery Office, price 3d.

MARCONI MEASURING INSTRUMENT EXHIBITION.—Marconi Instruments, Ltd., is showing a wide range of industrial measuring instruments at its London showroom, 109, Eaton Square, London, S.W.1. The exhibition will be open for two weeks March 14th (Monday) to 25th (Friday), and all interested in electronics and process control are invited to apply for admission tickets, either to Marconi Instruments, Ltd., St. Albans, Herts, or the London showroom. Among the exhibits will be the latest pH meters and moisture meters, a range of industrial recorders and a number of general-purpose instruments for widely differing applications. There will be many working models.

GLASGOW UNIVERSITY POST-GRADUATE LECTURES.—Post-Graduate Lectures arranged by the University of Glasgow, include the following: "Some Problems of Structural Analysis," by Dr. James Orr, M.I.Mech.E., on Wednesdays, January 19th, February 2nd, and 16th, and March 2nd and 16th; "Engineering Organisations and Construction Projects in the North American Continent," by Mr. Hugh B. Sutherland, A.M.I.C.E., on Wednesdays, January 26th, February 9th and 23rd, and March 9th and 23rd, and "The Design of Turbo-Compressors for Gas Turbines," by Mr. T. Martin Chalmers, on Mondays, February 14th, 21st and 28th. The lectures will be delivered in the James Watt Engineering Laboratories, Glasgow University, at 7.30 p.m., on each occasion. Payment of a registration fee of 5s. will give admission to any or all of the lectures, which are open to all engineers.

RADAR EQUIPMENT ON M.V. "MUNSTER."—On Wednesday last, January 5th, we saw, by invitation of Marine Instruments, Ltd., the marine division of Kelvin Hughes, Ltd., of 107, Fenchurch Street, London, E.C.3, a new instructional film which has been made in order to show the actual installation and operation of a marine radar set in the m.v. "Munster." That ship is one of a number on the Liverpool-Dublin run, which have been equipped with Kelvin Hughes radar instruments. Delivery from the factory to the ship is illustrated, and the setting of the installation to work, which was accomplished in three days. The display console, screened for use, and the control unit and aerial unit, with its rotating scanner on the bridge, are shown, and their working fully explained. The set is fully in accordance with the requirements of the Ministry of Transport, and is applicable as an aid to navigation, particularly to small and medium-sized ships. The film will first be shown in shipping circles, and later it may be released for general information purposes.

BRITISH ELECTRICITY AUTHORITY: EASTER AND SUMMER SCHOOLS, 1949.—Following the successful Summer School held at Magdalen College, Oxford, last year, the British Electricity Authority and the Area Electricity Boards are organising two schools for their employees this year. One is to be held at King's College, Cambridge, from April 2nd to 9th, and the other at Magdalen College, Oxford, from July 1st to 9th. A total of nearly 200 employees will attend the schools. A notice is being posted in all offices and works departments of the Authority and Area Boards, and any employee may make application to attend. The cost of travelling and board and accommodation will be borne by the Authority and Area Boards, and normal wages and salaries will be paid during attendance at the school. The programmes, which are in course of preparation, will follow similar lines to those of last year's school, and certain speakers will be in the position to review the first year's working of the Authority and the Area Boards. An innovation, however, will be the presentation of short papers by selected students on the nature of their own work. In addition, invitations are being sent to a number of personalities outside of the supply industry to give lectures on topics of general interest.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Association of Supervising Electrical Engineers

To-day, Jan. 14th.—CREWE BRANCH: Crewe Arms Hotel, Crewe, "Induction Smelting Furnaces," C. Osborne, 7 p.m.

Wed., Jan. 19th.—MANCHESTER BRANCH: The Engineers' Club, Albert Square, Manchester, "Radar," by a speaker from Metropolitan-Vickers Company, Ltd., 7 p.m.

Derby Society of Engineers

Mon., Jan. 17th.—School of Arts, Green Lane, Derby, "Developments in Locomotive Engineering," R. G. Jarvis, 7.15 p.m.

Diesel Engine Users Association

Thurs., Jan. 20th.—Caxton Hall, Westminster, S.W.1, "Recent Developments in Medium-Speed, Two-Cycle Oil Engines," C. B. M. Dale, 2.30 p.m.

Hull Chemical and Engineering Society

Tues., Jan. 18th.—Church Institute, Albion Street, Hull, "The Polishing of Metals," H. L. Coulson, 7.30 p.m.

Incorporated Plant Engineers

Thurs., Jan. 20th.—Liverpool Engineering Society, 9, The Temple, Dale Street, Liverpool, "Canteen Equipment Operation and Maintenance," C. W. Green, 7.30 p.m.

Institute of British Foundrymen

To-day, Jan. 14th.—MIDDLESBROUGH BRANCH: Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough, "The Production of Basic Electric Steel for Castings," L. Johnson, 7.30 p.m.

Sat., Jan. 15th.—BIRMINGHAM BRANCH, STUDENTS' SECTION: Visit to Works of the Incandescent Heat Company, Ltd., Smethwick, 9.30 a.m.

Fri., Jan. 21st.—FALKIRK SECTION: Temperance Cafe, Lint Riggs, Falkirk, "Core Shop Practice," A. L. Mortimer, 7 p.m.

Sat., Jan. 22nd.—BRISTOL BRANCH: Grand Hotel, Broad Street, Bristol, "Loam Moulding," W. H. Hornby, 3 p.m.——BURNLEY SECTION: Grammar School, Blackburn Road, Accrington, "A Day in the Foundry," R. Yeoman, 6.15 p.m.

Institute of Marine Engineers

Thurs., Jan. 20th.—Municipal Tech. College, Swansea, "Modern Marine Diesel Engines," J. Calderwood, 7 p.m.

Fri., Jan. 21st.—Tech. Institute, Falmouth, "The Importance of Scientific Training for the Young Marine Engineer," J. Paley Yorke, 7.30 p.m.

Institute of Metals

Fri., Jan. 21st.—SHEFFIELD LOCAL SECTION: Grand Hotel, Sheffield, "Thermocouples," R. C. Jewell, 6.30 p.m.

Institute of Refrigeration

Tues., Jan. 18th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1, "The Refrigeration of Biological Material," R. Gane, 5.30 p.m.

Institute of Road Transport Engineers

Thurs., Jan. 20th.—Royal Society of Arts, John Adam Street, W.C.2, "Diesel Engines," V. M. Pilkington, 6.30 p.m.

Institute of Transport

Mon., Jan. 17th.—Jarvis Hall, 66, Portland Place, W.1, "An Economist Looks at Transport," Roland Bird, 5.30 p.m.

Institution of Civil Engineers

To-day, Jan. 14th.—N.W. ASSOCIATION: College of Technology, Manchester, "Recent Developments of Pre-Stressed Concrete Structures," K. W. Mautner, 7 p.m.

Tues., Jan. 18th.—Great George Street, S.W.1, "The Brabazon Assembly Hall at Filton," C. B. H. Colquhoun, 5.30 p.m.——NEWCASTLE-UPON-TYNE AND DISTRICT ASSOCIATION: North of England Institute of Mining and Mechanical Engineers, Westgate Road, Newcastle-upon-Tyne, "Baghdad's Water Supply: Some Engineering Features," B. Whitteron, 6.15 p.m.

Institution of Electrical Engineers

Sat., Jan. 15th.—N. MIDLAND STUDENTS' SECTION: Yorkshire Electricity Board's Offices, Whitehall Road, Leeds, 1, Main Centre Chairman's Address, R. P. Horlock, 2.30 p.m.——LONDON STUDENTS' SECTION: Visit to Beckton Gas Works, E.6, 10 a.m.

Tues., Jan. 18th.—RADIO SECTION: Savoy Place, Victoria Embankment, W.C.2, discussion on "Should British Universities Consider the Establishment of Special Degrees in Radio?" opened by E. B. Moullin, 5.30 p.m.

Wed., Jan. 19th.—SUPPLY SECTION: Savoy Place, Victoria Embankment, W.C.2, "Sub-Stations, with particular reference to Yorkshire Practice," L. H. Fuller and C. R. Clarke, 5.30 p.m.——LONDON STUDENTS' SECTION: Visit to Kodak, Ltd., Wealdstone, Harrow. 2 p.m.

Thurs., Jan. 20th.—UTILIZATION SECTION: Savoy Place, Victoria Embankment, W.C.2, "Small Power Transformers for Aircraft Electrical Equipments," A. Langley Morris, 5.30 p.m.

Institution of Heating and Ventilating Engineers

Wed., Jan. 19th.—MANCHESTER AND DISTRICT BRANCH: Milton Hall, Deansgate, Manchester, Graduates' Competition Evening, 6.30 p.m.

Institution of Locomotive Engineers

Wed., Jan. 19th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1, "The Electric Locomotive in Switzerland: Its Latest Development, Mechanism and Some Problems," Gaston Borgeaud, 5.30 p.m.

Institution of Mechanical Engineers

To-day, Jan. 14th.—Storey's Gate, St. James's Park, S.W.1, "The Distribution of Load in Screw Threads," D. G. Sopwith: "Tensile Fillet Stresses in Loaded Projections," R. B. Heywood, 6 p.m.

Sat., Jan. 15th.—N.E. BRANCH GRADUATES' SECTION: Newcastle-upon-Tyne and Gateshead Gas Company, Grainger Street, Newcastle-upon-Tyne, "Some Differences Between Land and Marine Engineering Practice," P. L. Jones, 2.30 p.m.

Mon., Jan. 17th.—MIDLAND BRANCH: James Watt Memorial Institute, Great Charles Street, Birmingham, "Modern Steam Generators," W. C. Carter, 7 p.m.——S. WALES BRANCH: Institute of Engineers, Cardiff, "Some Features of Design and Construction of Electrical Overhead Travelling Cranes," A. C. M. Sigsworth, 6.30 p.m.——SCOTTISH CENTRE, AUTOMOBILE DIVISION: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, "The Fatigue Strength of Cast Crankshafts, R. J. Love and H. R. Mills, 7.30 p.m.

Tues., Jan. 18th.—LUTON CENTRE, AUTOMOBILE DIVISION: George Hotel, Luton, "Basic Problems in the Engineering of a Modern All-Metal Motor Body," E. S. White, 7.15 p.m.

Wed., Jan. 19th.—WESTERN BRANCH: Arts Centre, Swindon, "Mobile Locomotive Testing Plant of the L.M.S. Railway," H. I. Andrews, 7.30 p.m.——COVENTRY CENTRE, AUTOMOBILE DIVISION: Hare and Squirrel Hotel, Union Street, Coventry, Annual "Brains Trust," 7.15 p.m.——N.E. CENTRE, AUTOMOBILE DIVISION: The University, Leeds, Informal discussion, 7 p.m.

Fri., Jan. 21st.—Storey's Gate, St. James's Park, S.W.1, "Marine Engineering in the Royal Navy," Eng. Vice-Admiral Sir John Kingcome, 6 p.m.

Institution of Mining Engineers

Thurs., Jan. 20th.—Institution of Civil Engineers, Great George Street, S.W.1, annual general meeting, 11.15 a.m.

Institution of Mining and Metallurgy

Thurs., Jan. 20th.—Geological Society, Burlington House, W.1, "Mining and Milling Antimony Ore at Consolidated Murchison Goldfields, Transvaal," Ralph Symons, 5 p.m.

Institution of Post Office Electrical Engineers

Wed., Jan. 19th.—L.T.R. Headquarters Refreshment Club, Waterloo Bridge House, S.E.1, "Current Telephone Switching Practice in the U.S.A.," J. A. Lawrence, 5 p.m.

Institution of Works Managers

Thurs., Jan. 20th.—LONDON BRANCH: Waldorf Hotel, W.C.2, "Modern Lighting in a Factory," 6.45 p.m.——SHEFFIELD BRANCH: Royal Victoria Station Hotel, Sheffield, "The Work of the Production Efficiency Service," F. E. Chappell, 7 p.m.

Fri., Jan. 21st.—MANCHESTER BRANCH: Engineers' Club, Albert Square, Manchester, "Britain's Industrial Future," L. C. Ord, 6.30 p.m.

Junior Institution of Engineers

To-day, Jan. 14th.—39, Victoria Street, S.W.1, "The General Application of Gas and Coke for Domestic Heat Services," L. W. Andrew, 6.30 p.m.——WESTERN GROUP OF MEMBERS: Tech. College, Bath, "Astronomy and Engineering," H. Chatley, 7.30 p.m.

Fri., Jan. 21st.—S. MIDLAND GROUP OF MEMBERS: High School, Alexandria Avenue, Luton, "The Production and Uses of Industrial Precious Stones," N. J. Bowyer-Lowe, 7.30 p.m.

Sat., Jan. 22nd.—N.W. SECTION: 16, St. Mary's Parsonage, Manchester, "The Engineering Approach to Photography," L. H. A. Carr, 2.30 p.m.

Manchester Association of Engineers

To-day, Jan. 14th.—Engineers' Club, Albert Square, Manchester, "Paper-Making Machines: Some Essential Factors in their Design, Construction and Operation," G. H. Sheldon, 6.45 p.m.

North-East Coast Institution of Engineers and Shipbuilders

To-day, Jan. 14th.—Mining Institute, Newcastle-upon-Tyne, "Tanker Design from a Stability Point of View," N. H. Burgess, 6.15 p.m.

Wed., Jan. 19th.—STUDENT SECTION: Bolbec Hall, Newcastle-upon-Tyne, "Some Aspects of Scientific Management and Works Organisation," R. Loebl, 6.45 p.m.

Reinforced Concrete Association

Wed., Jan. 19th.—Institution of Structural Engineers, 11, Upper Belgrave Street, S.W.1, "The Repair of Concrete Structures," S. Champion, 6 p.m.

Society of Chemical Industry

Thurs., Jan. 20th.—Gas Industry House, 1, Grosvenor Place, S.W.1, "Cold Bituminous Constructions," L. G. Gabriel, 6 p.m.

Stoke-on-Trent Association of Engineers

Sat., Jan. 15th.—Electricity Department's Showrooms, Stoke-on-Trent, film, "They're Everywhere," 6 p.m.

RAILWAY ELECTRIFICATION IN SICILY.—It is reported that work on the electrification of Sicily's railways is expected to begin in the near future. The programme is said to include the construction of two electricity generating stations in Messina and Palermo, and it is stated that that the whole project will cost more than 32,000 million Italian lire.

Personal and Business

SIR JOHN BUCHANAN, C.B.E., F.R.Ae.S., has joined the Board of Dualloys, Ltd.

GENERAL SIR DARIL G. WATSON, G.C.B., has been appointed a member of the Railway Executive.

MR. J. R. PARTON has been appointed manager of the marine sales department of the Vacuum Oil Company, Ltd.

GENERAL AIRCRAFT, Ltd., announces that, with the approval of the Board of Trade, its name has been changed to Hanworth Securities, Ltd.

MR. J. F. PERRY has been appointed managing director, and Mr. F. J. E. Tearle general manager, of Metropolitan-Vickers Electrical Export Company, Ltd.

HATTERSLEY (Ormskirk), Ltd., announces the appointment of Mr. A. Nocton, as London representative, in succession to the late Mr. F. W. Ogborn.

MR. D. J. W. ORR, Mr. G. R. Daniel, Mr. D. Kirkwood, jun., and Mr. L. E. Oldridge have been appointed directors of the National Smelting Company, Ltd.

MR. JOHN DOUGLAS, M.I.C.E., M.I. Mech. E., M.I.E.E., announces that he is relinquishing his position as technical engineer in the Directorate of Disposals (R.E.), Ministry of Supply.

MR. R. C. DAWSON has joined the London and South territorial office of the English Electric Company, Ltd., Queen's House, Kingsway, W.C.2, to take charge of industrial motor sales in the area.

THE VIGZOL OIL COMPANY, Ltd., 113, Park Street, London, W.1, states that it has established an industrial lubricants department under the control of Mr. I. C. de Martonfalvy, chief engineer.

MR. H. C. SIDDELEY, of H. A. Roberts and Co., of Buenos Aires, informs us that he will be arriving in this country about the end of this month and that his address will be Goring Hotel, Ebury Street, London.

BAYLISS, JONES AND BAYLISS, Ltd., states that Mr. F. Usher-Smith and Mr. R. M. Hyslop have been appointed managing directors, consequent upon the retirement of Mr. P. S. Bayliss and Mr. F. W. Bayliss.

BECK AND POLLITZER, Ltd., announces the formation of a subsidiary company known as Beck and Pollitzer (Africa) (Pty.), Ltd., 3, Yorkshire House, Cr. Marshall and Rissik Streets, Johannesburg (telegraphic and cable address, "Hookup," Johannesburg).

THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH announces that the Director of Hydraulics Research, Sir Claude Inglis, M.I.C.E., and the London office of the Hydraulics Research Organisation have moved to Rex House, 4–12, Regent Street, S.W.1 (telephone, Whitehall 9788, Extension 16).

LONDON TRANSPORT announces the following changes in its organisation:—Mr. F. A. A. Menzler, chief development and research officer, assumes administrative responsibility for the central laboratory and the three generating station laboratories; Mr. A. T. Wilford, chief chemist, becomes superintendent of laboratories; and Mr. T. J. Stammers, divisional engineer "C," is appointed an officer of the Executive.

BROWN BAYLEY'S STEEL WORKS, Ltd., announces the following appointments: Mr. E. W. Fiddian, Birmingham office manager, on the retirement of Mr. R. U. Bailey; Mr. A. Hewer, representative in the Birmingham area; Mr. H. E. Clark, London office manager, in succession to Captain M. K. F. Saunders, who is retiring owing to ill-health, and Mr. Philip Kemp, Sheffield representative, on the retirement of Mr. H. E. Scott.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., announces that its Warrington works have been engaged in the manufacture of sintered carbides under an agreement by which the whole of the output has been sold to Cutanit, Ltd. A new company has now been registered under the name of Metro-Cutanit, Ltd., to combine the production of the Warrington works with the technical and commercial activities carried out by Cutanit, Ltd., and by Compound Electro-Metals, Ltd. Mr. I. R. Cox, managing director of Metropolitan-Vickers Electrical Company, Ltd., is the chairman of Metro-Cutanit, Ltd., the registered office of which is at 42, Pall Mall, London, S.W.1.

Contracts

THE BRUSH ELECTRICAL ENGINEERING COMPANY, Ltd., has received an order from the Steel Company of Wales, Ltd., for four 0–6–0 diesel-electric shunting locomotives for use at the Steel Company's works at Port Talbot.

A Seven-Day Journal

Engineering Industries Association Exhibition

In order to provide its member firms with an opportunity to see each others products, the London region of the Engineering Industries Association held a one-day private exhibition on Tuesday, January 18th. At this exhibition, the first of its kind to be held by the Association, it was possible for the visitor to get some impression of the wide variety of products for the light and medium engineering and allied trades now being made in the London area. The products displayed, in addition to a wide selection of precision equipment, tools, mass-produced machine components, optical and electrical instruments, pressings, forgings, &c., also included many types of finished goods and machines for the domestic and foreign markets. A noticeable point with all the exhibits was the high standard of workmanship and finish which has been attained. Many of the firms showing their products were established prior to the war, but quite a high percentage were firms which started during the war and which have now transferred their attention to the manufacture of goods in normal daily demand. In its work of assisting both these old and new firms in saving the time and expense involved in searching for work or productive capacity the Association believes it is serving a very useful purpose. The Association has more than a thousand members in the London region, and it was regretted that the space available for the display made it necessary to restrict the number of exhibitors to a little over 200. It is hoped that the exhibition will be the forerunner of similar displays which will be of longer duration, and in which it will be possible for more member firms to be represented.

British Overseas Airways Corporation

The Minister of Civil Aviation announces that Sir Harold Hartley, F.R.S., has informed him of his wish to resign from the chairmanship of the British Overseas Airways Corporation, when his present term of office comes to an end on June 30, 1949. The Minister has, with much regret, accepted Sir Harold's resignation. Sir Miles Thomas, the present deputy chairman, has accepted the Minister's invitation to become chairman in succession to Sir Harold Hartley. Sir Miles Thomas will be succeeded as deputy chairman by Mr. Whitney Straight, who will continue to be chief executive of the Corporation. Sir Harold Hartley, who, last September, celebrated his seventieth birthday, has had a distinguished teaching and business career. In 1918 he was Controller of the Chemical Warfare Department of the Ministry of Munitions. After that war, he returned to Balliol and resumed teaching and research. In 1922 he joined the board of the Gas Light and Coke Company. He finally left Oxford in 1930 in order to become vice-president and director of research of the former L.M.S. Railway. From that time onwards Sir Harold took a strong interest in aviation, and was chairman of Railway Air Services from 1934 until he joined the B.O.A.C. During the last war he was chairman of the committee which dealt with the country's internal air services, and was chairman of the Management Committee of the Government Aviation Fuel Factory. At the beginning of 1946 Sir Harold gave up all his other activities to join the board of the B.O.A.C., and to take charge of its European division before the B.E.A. was created. In August, 1946, he was made the first chairman of B.E.A., and one year later he was appointed chairman of the B.O.A.C., from which he will be retiring when his term of office expires next June.

James Watt International Medal

The Council of the Institution of Mechanical Engineers has awarded the James Watt International Medal to Dr. Fredrik Ljungström, of Sweden, for his outstanding contribution to the development of mechanical engineering, the most notable of which is the air preheater, which bears his name and the steam turbine developed jointly with his brother, the late Birger Ljungström. Dr. Ljungström was nominated by the Swedish Society of Engineers. In creating the award, the Institution of Mechanical Engineers decided to commemorate the event of Watt's birth over two centuries ago, which was destined to bring about a revolution in the utilisation of power, by the award every two years of a gold medal to an engineer of any nationality deemed worthy of the highest honour the Institution can bestow, and that a mechanical engineer can receive. In making the award, the Institution has secured the co-operation of the principal engineering institutions and societies in all parts of the world as nominating authorities. To be worthy to receive a medal struck in commemoration of one who was at the same time a scientist, an inventor and a producer, the recipient himself should be an engineer who has achieved international recognition both by his work as a mechanical engineer and by the ability with which he has applied science to the progress of mechanical engineering. The Institution recognises, however, that only rarely will it be possible to find men in whom those qualities are so equally balanced as they were in James Watt. It therefore considers the merits of men who have attained world-wide eminence in mechanical engineering in any direction—science, and research, invention and production. Hence, a great thinker or teacher, though he be not a designer or inventor, or a great organiser of methods of production in engineering works, is eligible for the medal.

British Iron and Steel Research Association

It is announced that the British Iron and Steel Research Association has decided to admit all firms and individuals interested in the manufacture and use of iron and steel, but not themselves makers or processors, to a newly established category of associate membership. Since the formation of the Association in 1945 its activities have been largely concerned with the making and shaping and the properties of iron and steel. Its researches relate closely at one end with the industry's suppliers of raw materials and capital equipment, and at the other, with users of its products. Co-operation at each end has been close. Thus, work on the design of a new plant involved suppliers, whilst work on a variety of corrosion problems involved users to a considerable extent. The present step carries such co-operation a step further, and gives firms or individuals of allied or interested industries a more direct opportunity of influencing the Association's research programme, which at present numbers some 400 projects. Associate members will, moreover, receive research reports, and will be able to attend the technical conferences which are a feature of the Association's information methods. About twenty such conferences are held yearly, covering almost every aspect of the Association's work. The organisation of the B.I.S.R.A. into six largely autonomous divisions enables associate members to restrict their participation to selected fields. Trade associations are not eligible, and in the fields of coke and refractories such close collaboration between the B.I.S.R.A. and the respective research associations already exists, with full exchange of information, that membership by firms in those industries would serve little practical purpose. Associate members will be drawn, it is expected, from a wide range of other industries.

Institution of Electrical Engineers' Honorary Member

For his distinguished contributions to electrical power engineering, particularly in the fields of generation, transmission and distribution, and for his services to the Institution of Electrical Engineers, Captain J. M. Donaldson, M.C., has been elected to honorary membership of the Institution. John Muir Donaldson was educated at the Whitgift School, Croydon, and received his technical training at the Finsbury and Central Technical Colleges. His early experience of power engineering from 1897 to 1906 were gained mainly in England with the British Thomson-Houston Company, Ltd., but this period included a year with the General Electric Company in Schenectady, followed by three years (1901–1903) with the Montreal Heat Light and Power Company. The long association with electric power supply developments in Great Britain began in 1906, when he was appointed general assistant engineer to the North Metropolitan Electric Power Supply Company. In 1920, Captain Donaldson became chief engineer of the company, and in 1936 he was appointed general manager and held this position until 1943, when he was appointed a director of the company. Under his technical guidance the Northmet system grew to be one of the largest co-ordinated power supply networks in Great Britain. He was responsible for important pioneer work in the practice of electricity supply, particularly in the use of steam at high temperatures and pressures in Brimsdown and Willesden power stations. He now serves as a member of the Eastern Area Electricity Board. His active association with the I.E.E. began in 1896, when he became a student. After being elected an associate in 1898 and a member in 1912, he served as a Member of Council from 1923 to 1926, and as a Vice-President from 1927 to 1930. In 1931 he was elected President of the Institution. He has served as a member of a number of Committees of Council and has taken special interest in the training of electrical engineers. During the Great War of 1914–18, Captain Donaldson served with the King's Royal Rifle Corps and was awarded the Military Cross.

Faraday Medal

The Council of the Institution of Electrical Engineers has made the twenty-seventh award of the Faraday Medal to Mr. C. S. Franklin, for his outstanding work in radio engineering and, in particular, his original studies of short-wave wireless transmitting and receiving circuits and his invention of the beam aerial which helped to establish the practical use of short-wave transmission paths for communication. Charles Samuel Franklin was born in 1879 and studied at Finsbury Technical College under Professor Sylvanus Thompson. In 1899, he joined Marconi's Wireless Telegraph Company, which was then known as the Wireless Telegraph and Signal Company. For the next thirty-six years he was continuously associated with research and development in radio engineering, with the same company. Although he retired from active work in 1935 he still remains a consultant to the company. During his long career he has been responsible for many outstanding technical advances, including reaction patents for wireless receiving circuits, early British broadcasting stations, directional receiving systems for long-wave communications circuits, rotating beam aerials and short-wave transmitting and receiving circuits. In particular his name is associated with the beam aerial array which formed the foundation for the beam system of wireless telegraphy. He also developed the concentric cable system which allows high-frequency currents to be transmitted with minimum loss—an essential link in television practice. Mr. Franklin joined the Institution as a member in May, 1928, and is a member of its Radio Section. He was the first recipient of the James Alfred Ewing Medal, which was instituted in 1936 in memory of Sir Alfred Ewing, to be awarded by the Institution of Civil Engineers for specially meritorious contributions to the science of engineering in the field of research.

Critical Review of Gas Turbine Progress

No. II—(*Continued from page 45, January 14th*)

(*Contributed*)

Immediate Prospects and Competitive Position of Gas Turbines

Efficiency is commonly regarded as the criterion of performance of a prime mover. This is a mistake. Running cost is the decisive factor, efficiency being of mainly academic interest. For this reason, the diesel, with its efficiency of 35 to 40 per cent, has not been able to displace steam plant in large power stations, whose efficiency is no better than 30 per cent. If the gas turbine is confined to oil at twice the price of power station coal on a thermal basis, its chance of displacing the steam cycle is also slender, though it has the prospective advantage over the diesel of being made in units of larger size and with expected lower maintenance. It is to be noted that gas turbine performances are commonly quoted as test efficiencies and on the lower calorific value, whereas power station figures are inclusive of auxiliary power consumption and relate to average conditions in service over the entire year. They are also based on the higher calorific value. Hence, to equal a fairly normal modern power station figure of 27·5 per cent on coal, a gas turbine would have to show a test efficiency on the usual basis of 65 per cent. This is outside present expectations and so the gas turbine shows no immediate prospect of competing in the base-load field. Accordingly, application in power generation must be confined to special circumstances, peak or standby sets, or for base-load utilisation only in oil-producing countries where coal is not cheap.

Coal Burning

For this reason there is interest in the prospect of burning coal. In 1944 the coal interests in the U.S.A. began to view with alarm the trend towards the use of the diesel in main-line railway haulage. Accordingly, Bituminous Coal Research Inc., decided to sponsor research on the development of the gas turbine locomotive burning pulverised coal, and two gas turbines were ordered, one of 4000 h.p. from Allis Chalmers, for installation in an A.L.C.O. locomotive, and the other, of 3750 h.p., from the Elliott Company, for fitting in a Baldwin locomotive. The firing equipment and the combustion chambers were the responsibility of the purchaser. Development work on the project was distributed among a number of university and other research units. Now, after four years, the machines are practically completed, but the high hopes that were entertained of an early solution to the problem are somewhat dashed. The notion that the coal particles would be burst asunder by the sudden expansion of air soaked into them under pressure and then released has proved incorrect. An even more serious difficulty lies in removing the ash from the gases before they enter the turbine. The ash is associated with unburned coal and this burns fiercely in the cyclones which are quickly destroyed. Even if this could be overcome it is probable that the change of resistance of the circuit with the degree of fouling of the cleaning device would so interfere with the performance of an axial compressor as to render the scheme unworkable. The Elliott Company is proposing to use a centrifugal machine, possibly for this reason.

The alternative of burning coal in a separate combustion chamber in conjunction with a closed-circuit turbine has not yet been tried. The inherent difficulties do not seem so outfacing as in the internal method, since the technique is not far removed from those familiar in boiler practice. However, even if it proves possible to burn coal in an air heater it is uncertain whether the gas turbine will then show any immediate decisive advantage as compared with steam plant. The efficiency at present obtained with a temperature of 1250 deg. Fah. (after allowing for the method of specifying) is not substantially better than that obtainable with steam cycles using lower temperatures, say 950 deg. Fah., which can be assumed to involve less trouble. It is uncertain whether the plant cost will be any lower or whether the operating characteristics will be as convenient. The gain for every 100 deg. Fah. rise of temperature is about 7 per cent in the air cycle as against only 3·5 per cent in steam cycles, but this does not become of account until the lines cross at about 1400 deg. Fah., up to which point a steam cycle shows a better performance than an average gas cycle using the same temperature. It will be understood that the gas cycle can be improved at all points by the addition of more regenerator surface at inordinate increase of cost.

There remains for consideration the so-called two-stage combustion method, in which the coal would be completely gasified in a separate producer and the gas burnt in the combustion chamber proper. This can take either of two forms, the atmospherically-fired producer and the pressure-fired. In the first the producer is a separate plant working at approximately atmospheric pressure, and the gas may be washed, detarred and stripped of its by-products before being compressed by a gas blower. The cycle involves no unfamiliar technical problem. It is, however, rather wasteful in involving heat losses from the producer and the sacrifice of the sensible heat in the gases. These must be cooled to a low temperature to reduce compressor work, since the gas is rather poor. It also entails fairly heavy additional capital expenditure so that the gain compared with orthodox practice is difficult to discover. The proposal has therefore been made to supercharge the process by connecting the producer after the gas turbine compressor. This would reduce the physical size, so saving capital cost, and as the gas turbine would handle the gas hot there would be less loss of sensible heat. However, this entails dispensing with washing and by-product recovery and involves the risk of fouling trouble in the turbine with tar and dust. Experimental work on these lines is to be carried out in this country, probably using a design based on the "Lurgi" producer, developed in Austria, which is capable of working at ten atmospheres pressure on lignite.

Marine Purposes

The prospects in the marine field seem rather more favourable since a large fraction of marine plant burns oil already. Moreover, the efficiency of steam plant at sea is fairly moderate, normally in the region of 15 to 20 per cent and rarely as high as 25 per cent. Gas turbine plant can fairly readily offer an efficiency of 25 to 30 per cent without excessive complication and probably with considerable saving in weight. Intercooling will be called for, but this is no disadvantage at sea, though there will be some reduction of output and some sacrifice in efficiency in tropical waters. The variable-speed drive also suits the gas turbine and permits of keeping up the part-load efficiency. If it could equal steam on other counts, namely, simplicity, manœuvrability and reliability, and if steam were its only competitor, the gas turbine would appear to be favourably placed. However, it must also face competition from the diesel engine, which in the slow-speed form used at sea is capable of test efficiencies as high as 40 per cent. This is partly offset by the higher cost of diesel oil at London of, say, £7 15s. per ton, compared with bunker oil at £6 10s. per ton and by high lubricating oil consumption and greater weight and space in the case of the diesel. However, ships' engines may require to run continuously for a large fraction of the year and hence the fuel bill is of prime importance, as already touched on. For this reason there is interest in gas turbine cycles designed for marine duties with very high efficiencies, e.g., 34 per cent. One problem which has not yet been solved is the provision for astern running. So far all proposed marine gas turbines have avoided the issue either by the use of electric drive or a reversible propeller, but both of these must be regarded as severe drawbacks.

In the naval application the service hours in a normal year may be small, whereas saving in weight and space are of vital account. Fuel economy has, however, to be considered as fixing the cruising range while an important feature is ability to obtain increased output for a limited time, even at considerable sacrifice in economy. The gas turbine in a specialised form may be able to fulfil these requirements by the temporary use of much higher temperatures.

Locomotives

An early application of the gas turbine was to the locomotive and, following the 2000 h.p. Swiss locomotive built in 1940, some ten further units are built or being built, seven of them for actual locomotives. Conditions in this country appear generally favourable, since in the first place competition is with the established non-condensing steam engine. This has a service efficiency at the rail of approximately 6·5 per cent, hence, if oil-fuel costs twice as much as locomotive coal, the gas turbine needs to attain only 13 per cent efficiency to equal the fuel cost. This calls for about 17 per cent at the coupling, which has already been attained at most economical rating, and slightly better figures may be expected in some future sets. The likelihood of attaining very much better figures in locomotives is remote. Space does not permit of incorporating a large regenerator. Intercooling is clearly ruled out. Hence only the simple cycle can seriously be considered. The incorporation of the Comprex, while raising the output markedly, improves the efficiency by only a small amount. A small cross-flow regenerator may be used, as by Brown-Boveri, for improving part-load performance, while possibly reducing full-load performance. Raising of the initial temperature, as has been done in American plants, has so far not shown any benefit in increased efficiency, though it should do

so if the velocities are not run too high in an effort to reduce weight. The falling off in performance in tropical temperatures will be serious, while the benefit of low ambient temperature is correspondingly great.

The gas turbine locomotive with electric drive, which is universally employed, is expensive and will need to show a very high availability in service in order to justify the higher capital cost. The opportunities for the full utilisation of a large high-speed locomotive in this country are somewhat restricted and only where it is fully utilised can the gas turbine show to advantage as compared with the diesel. The diesel, with, say, 35 per cent coupling efficiency, will consume about half as much fuel at full load. In normal service, which is heavily weighted with light-load running, the ratio of consumptions may be 1 to 3. This is too large a discrepancy to be readily offset by difference in lubricating oil consumption or in maintenance. However, the gas turbine is still at an early stage in its career and may be able to reduce the disadvantage in future designs. There are other considerations, such as the saving in length of the gas turbine locomotive in large ratings, which may be of account where platform lengths are limited.

In the U.S.A., where the diesel locomotive is already fully entrenched, the oil-fired gas turbine locomotive is likely to have a very uphill task in displacing it. Nevertheless, manufacturers have taken the risk in building trial types as speculations with a view to establishing their behaviour in actual service. One such machine made by A.L.C.O., with G.E. turbine, is about to start trial running on the Union Pacific Railway.

Because of the high cost and losses involved in electric transmission there are hopes in some quarters of using direct mechanical transmission. The argument is offered that the gas turbine can give double full-load torque at starting and that this is sufficient without the use of clutches or gears. It may be noted that the electric drive can give about seven times full-load torque. The necessity for braking the direct-coupled gas turbine as well as the train is objectionable, whereas with electric drive the machine can even be employed to assist the brakes. A gearbox cannot in any case be dispensed with because of reversing. It is significant, moreover, that no proposition has yet been put forward on such lines by a responsible party and every one of the eight locomotives at present built or under construction will use the electric drive.

Automobile Plant

Despite enthusiastic announcements made in the press concerning developments in automobiles it is doubtful whether such notions are to be regarded seriously. Failing some radically new invention, gas turbine plant must suffer from an inherent scale effect, so that units of smaller output, even when the speed is raised to suit, must show a poor performance by reason of a lower Reynolds number. It is also clear that for mobile plant the complications such as compounding and the use of inter-cooling and regeneration, which are responsible for the efficiencies beyond 20 per cent obtained in heavy stationary plant, would be out of place.

Consider, for instance, the M.G.B. set of 2500 h.p., with its efficiency of 13 per cent at full load and, say, 9 per cent at cruising speed. There is little prospect of a 25 h.p. unit for a motor-car attaining efficiencies anything like so good, and the poor part-load efficiency would be a distinct drawback in automobile use since the full output of an engine is so very rarely utilised. There are other practical snags such as the emission of large quantities of exhaust gas at 1000 deg. Fah., or higher, which might be regarded as a nuisance. The gearbox could not be dispensed with since aside from reversing, the starting torque at twice full-load torque, though considerably better than in the case of a petrol engine, would still not be acceptable. Startability would be distinctly inferior to the petrol engine; a great deal of energy would have to be put into the high-speed rotating parts to bring them up to igniting speed and this would call for the carrying of enormously heavier batteries. Since hand-cranking would be completely out of question, an inertia starter would have to be employed as a standby. It is unlikely that an explosive starter would provide the requisite characteristics.

Even in much larger units up to, say, 1000 h.p., it seems very doubtful whether the gas turbine can be made in a form which will compete seriously with petrol or diesel engines on land. Even for stationary purposes, in this order of size compound sets and the other refinements of recooling and regeneration would be regarded as an inconvenience, but without them not only does the best efficiency remain low but also the part-load performance is distinctly poor compared with a diesel even in variable-speed applications. In the constant-speed application the part-load performance of a simple gas turbine is particularly bad, and there can be few applications where a small unit could be put in with the assurance that it would be run at full load substantially for most of its time.

Considerations Affecting the Choice of Maximum Temperature

The general consensus of opinion seems to be that a temperature of about 1200 deg. Fah. is permissible for a life of 100,000 hours. It is not clear what is the basis of this opinion since none of the alloys favoured has been subjected to endurance tests of this duration. There are indeed exceptions to the view. Brown-Boveri, the only firm with any considerable number of machines to its credit, does not go above 1100 deg. Fah. It has not, however, adopted highly refractory blade alloys but preferred to adhere to moderately alloyed steel, with which it has long experience and an assurance of retention of ductility. At the other end of the scale are the aircraft gas turbine builders, using 1500 deg. to 1600 deg. Fah., with lives of 300 to 500 hours. They are, however, working in a region where they can readily find out how long the material will stand up by a process of trial and error. In this country it is generally assumed that high-temperature blades will be in Nimonic, but its use in long service is not yet proven and other alloys are employed in Switzerland and America.

In the U.S.A., though a temperature of 1200 deg. was also regarded as a reasonable figure for continuous service a few years ago, several recent sets employ temperatures between 1350 deg. and 1470 deg. Fah. It is possible that the life will be limited to 10,000 hours or some such figure, which would not be irrational, considering that plant in standby or peak-load service can hardly need a service life of more than 20,000 hours. Escher Wyss also adopted the very high temperature for the time of 1300 deg. Fah. in its 2000-kW pioneer closed-circuit unit, which has now operated some 3500 hours, including a non-stop run of 1250 hours last winter. In its larger sets it has, nevertheless, decided to limit the maximum temperature to 1250 deg. Fah., possibly because it is using materials of different origin.

As is well known, the prospective gain by increasing the temperature is very marked, not only does the efficiency improve approximately 7 per cent for each 100 deg. Fah., but also the net output increases so that the cost per kilowatt and, what is in some applications of more importance, the weight per kilowatt diminishes. Hence, there is considerable research interest in the use of still higher temperatures. To this end the notion of using ceramic blades continues to have its followers. It is an old idea and ceramic nozzles were actually employed in a gas turbine more than forty years ago. It seems probable that the difficulties then encountered are fundamental, namely, that with age or continuous changes in temperature associated with stress, ceramic materials tend to lose their amorphous character and assume a crystalline form, which is characterised by embrittlement. The same seems to happen also with refractory alloys to some extent. Most ceramics are also sensitive to thermal shock. Moreover, the blades are not likely to be the only limitation. The blade-fixing in the rotor may be equally highly stressed, hence there are proposals to adopt cooling of the rotor and possibly of the blades, either by water or air.

The water cooling proposals are adopted from the German work at Völkenrode, and are derived from the Atmos, Vorkauf and Huettner boilers, which were actively canvassed in the 1930s. There is in fact a great inclination for research circles to be impressed by Continental ideas, which were common knowledge prior to the war. The air-cooling proposition has more to recommend it, provided it can be shown that the quantity of cooling air required is not sufficient to offset seriously the gain obtained with the high temperature in reducing the ratio of compressor work. The full potential gain from raising the initial temperature is realised only if the exhaust temperature remains unaltered. This can be assured either by increase of pressure ratio or by the use of a regenerator. The use of the higher pressure ratios calls for inter-cooling. This is applicable in naval vessels but seems to be ruled out in locomotives or in aircraft. Similarly the regenerator cannot be applied in mobile plant in high thermal ratio because of the weight and bulk of the tubular type. Hence, neither in aircraft nor in locomotives can high temperatures be utilised to advantage. There is research interest in the rotating type of regenerator similar to a Ljungstrom preheater, again following German ideas, but even if the leakage and displacement difficulties can be overcome, its use in the form favoured, namely, with very fine passages to keep down bulk and weight, would be restricted to those cases where the medium will be perfectly clean on both sides, which in practice seems to confine it to the closed cycle, or to open cycles in very clean air and with no risk of bad combustion.

The casings of gas turbines, usually in 1 per cent chromium-molybdenum, do not impose any very serious limit on temperature. There is a tendency in any case to adopt what amounts to a double casing construction in which the highest temperature gases are prevented from coming into contact with the main casing by means of an internal thin wall of heat-resisting alloy. The stator blades are commonly carried on an internal blade ring, supported from

the outer casing by means of radial faces, which permit of relative expansion without loss of concentricity. Such blade rings, being thin, expand more rapidly than the rotor on starting up and hence ensure increased clearances. To this must be attributed the very short starting-up times shown by certain open-circuit gas turbines. In the converse operation, namely, shutting down, when the stator tends to cool faster than the rotor, safety is provided by the use of turning gear so as to avoid bending of the shaft and to redistribute the temperatures between top and bottom. Hogging of the casing is rendered less serious by the use of internal blade rings, provided the plane of the support is correctly chosen and the clearances suitably adjusted.

Mixed Fluid, Binary and Waste-Heat Cycles

In all countries there has been a recrudescence of ideas of using mixed steam and air cycles or binary cycles. This seems to be a throwback to the early days of the gas turbine, when it was unable to make headway as a prime mover on its own account. It will be remembered that the Holzwarth machines had to introduce cooling water and that the Velox boiler, which is in a way a mixed gas and steam cycle (the only one so far to attain any practical status), grew out of the Holzwarth experiments.

The objection to mixed cycles is in general that they are "messy." They involve duplication of components and numerous auxiliaries. They must be, one feels, more costly both in capital and maintenance than a simpler cycle restricted to either air or water. Their yields on paper may be very high, but inventors in their enthusiasm frequently omit to calculate the weights and surfaces of the waste-heat boilers required, merely assuming that a boiler will bear some relation to the familiar units in which fuel is burnt direct. It is, of course, the fundamental defect of the orthodox boiler that it permits so great an irreversible drop between the flame and the highest temperature utilised in the engine, but this thermodynamic defect can also be regarded as a practical virtue in that it reduces very markedly the surface required.

Mixed cycles commonly involve some hidden snag to which the inventors tend to close their eyes or to which they are possibly oblivious. The most common proposal is to introduce a gas turbine in the combustion circuit, using its exhaust gases for combustion air. It can then furnish some power apparently at the expense of practically no heat rejection, i.e., at, say, 4000 B.Th.U./kWh at the generator terminals. Unfortunately, it is generally found that this involves forfeiting or restricting the gain by the use of bled steam feed heating in the main cycle, and since this part of the steam cycle has also practically 80 per cent efficiency, little advantage is gained. This snag is encountered in the Velox cycle, since the combustion air cannot be used effectively after compression to extract low-temperature heat from the exhaust gases. This duty must accordingly fall on the economiser but in an efficient regenerative steam cycle the feed is already too hot at entry into the economiser. Hence the apparent gain in the highly efficient boiler has to be offset by a sacrifice in the cycle. The Velox boiler and its imitator, the Sural, is accordingly restricted in application to cases where bleeding is not desired and especially to those applications where reduced weight is important.

The Karrer proposal, in which a gas turbine would be combined with a steam plant in a different way, suffers from the same defect. The proposal is to employ an open-circuit gas turbine, taking in air, compressing it and picking up heat in a tubular heater incorporated in the passes of an existing steam boiler. The heated air, after driving the gas turbine, would be used as hot combustion air in the boiler. The scheme has the merit of making use of some of the furnace heat at a higher temperature than do orthodox steam cycles. It does, however, clearly eliminate the combustion air preheater and therefore is best applicable to cases where cold feed is employed. Dr. Keller, of Escher Wyss, has proposed to overcome this difficulty by supplying the heat to the gas turbine not from the boiler proper but from the flue gases by means of an air heater. This may benefit the combustion appliance but any gain in efficiency seems to be illusory, as the outlet temperature of the flue gases is still limited as in the Velox.

Several other proposals have been made, involving combustion chambers with air-cooled tubes in place of the water walls of familiar steam practice. A decision on their practicability hangs on the success of the Escher Wyss closed-circuit gas turbine in large sizes as is being installed in Paris. The Paris 12,500-kW unit, designed for oil-firing, is expected to run within about six months. The problem of adapting the type to coal-firing remains, however, to be tackled. A development of this class is the "equi-pressure" boiler, which is related to the Velox but carries the supercharging of the combustion process very much further. According to the proposals of Monsieur Mercier the combustion space is to be pressure-fired to the same pressure as in the water space, say, 1500 lb per square inch. Free piston compressors are to be used and the whole of the exhaust heat recovered in gas turbines. The boiler would raise steam to drive steam turbines. The scheme has already been tried out experimentally in Paris at 500 lb per square inch and a 12,500-kW set is under construction. A similar proposal has been put forward by R. W. Bailey, of Metropolitan-Vickers, but without carrying the supercharging to the same pressure as in the steam space.

Binary cycles in which the waste heat rejected is to be put to use elsewhere have a sort of Micawber outlook. They are virtually a confession of failure of the gas turbine as an outstanding prime mover in its own right. Their applicability depends on finding a customer prepared to pay for the exhaust heat and to take it at the temperature offered and in the quantity determined by the power output. The principle is unquestionably sound and if the gas turbine could use coal so that the heat could be sold at a price equivalent to that at which it could be raised by the prospective customer in his own boilers, the proposition would have some merit. The gas turbine is, however, in competition in this field with orthodox back-pressure steam equipment. It is true that the gas turbine has the advantage of rejecting its exhaust heat at a high temperature, unlike the steam cycle, which, by contrast, has to sacrifice work output in order to raise the temperature of rejection. However, the steam cycle uses coal at half the price of oil—which diminishes the cost of both the useful and the waste heat. In the back-pressure form it can also dispense with a good deal of equipment since the customer becomes the condenser. The gas turbine on the other hand requires a waste-heat boiler and as mentioned above the proportions of such boilers, especially when required to impose low resistance, tend to become rather alarming. The main defect of such proposals remains that of finding a customer for the embarrassing quantities of heat. However, if the proposal is inverted and the gas turbine is installed where heat is required, then it takes on a different colour. One such practical case is in the Huey station in Oklahoma, where the General Electric Company is installing a 3500 kW gas turbine fired by natural gas and arranged to utilise its exhaust heat for heating the condensate from old steam turbines not provided with bled steam connections. In this duty the power is virtually a by-product and a low efficiency of 17 per cent, based on power output in relation to fuel consumption, is acceptable. A more efficient set would simply make available more power but possibly at a disproportionate expenditure of cost and space.

A recent proposal by J. F. Field consists of using steam in a closed-circuit compressor-turbine cycle so that the heat is rejected in the form of low-pressure steam without the use of a waste-heat boiler. Recirculation of a large quantity of steam in the cycle overcomes the usual objection to a superposition steam cycle that the work per pound of exhaust steam is severely limited for any practical initial pressure.

The converse, namely, the running of a gas turbine on waste heat, is, of course, quite practicable. The Houdry units used in oil-cracking plants, of which there are some thirty-four in service, are an example, which paved the way to the development of the gas turbine as a prime mover. In this case power output is really a secondary consideration since the duty is primarily to burn solid carbon off the catalyst. The compressed air not only does this effectively but also the heat of combustion provides some excess energy.

A recent example in this country is in the use of a 600-kW closed-circuit gas turbine at Coventry gas works, to be used for the abstraction of heat from hot gases. There is probably an extensive field for such applications, e.g., at coke ovens, where considerable heat is still thrown away. The defect of such plant is the rather disappointingly small output obtainable and the high capital cost of the plant though this might be reduced by simplification.

The use of the gas turbine in metallurgical work is a somewhat related application, which offers considerable possibilities. For instance, in steel works the gas turbine can consume blast-furnace gas and provide the blast by tapping the compressor. One such unit is on order from Brown-Boveri for Spain, and another for Luxembourg. One of the units supplied by Brown-Boveri, Mannheim, to the Hermann Goering Steel Works before the war, has now been brought to England.

London University Physics Lectures.—A course of three lectures on "The Application of Atomic Piles in Nuclear Physics," is to be given by Sir John Cockcroft, F.R.S., at the University of London, Senate House, Russell Square, W.C.1, on Wednesdays, February 2nd, 9th and 16th, at 5.30 p.m. The lectures are intended for students of the University and any others interested in the subject. Admission is free and no tickets are required.

The Purchasing Officers Association.—The Rt. Hon. Lord McGowan, K.B.E., chairman of Imperial Chemical Industries, Ltd., has accepted an invitation to become the first patron of the Purchasing Officers Association. The Association, which was founded in 1931, now has a membership of 1750 purchasing officers in all branches of industry and public administration. Its headquarters are at 17/18, Henrietta Street, London, W.C.2, and twenty-one branches have now been established in the principal cities of the country.

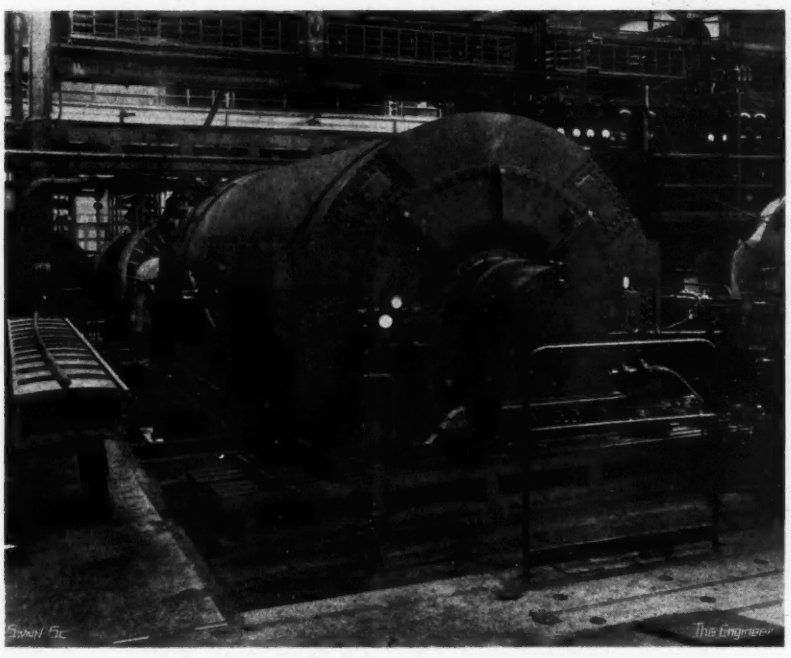
Electrical Engineering in 1948

No. II—(*Continued from page 43, January 14th*)

ALTHOUGH the manufacture of generating plant, in common with electrical equipment generally, continued in 1948 to be governed mainly by the demand for increased production, it should not be supposed that technical progress was seriously retarded thereby. Thus, one effect of the regulation standardising the output and steam conditions of turbo-alternators was to emphasise current developments on high-pressure steam plant in this country. Considerable interest was aroused by Mr. W. N. C. Clinch's paper* "Some Operating Experiences with High-Pressure Steam Power Plant," which contained interesting and useful data relating to the pioneer installations at Brimsdown and Willesden power stations.

Additional experience with high-pressure plant should be gained with the commissioning this year of a 60-MW Metropolitan-Vickers hydrogen-cooled turbo-alternator at Littlebrook "B" power station, which will operate with steam conditions of 1250 lb per square inch, and 825 deg. Fah. Departures from orthodox practice will also be made at Stourport "B" power station, where, as already mentioned, two hydrogen-cooled 60-MW English Electric turbo-alternators will be installed by 1952, with steam conditions of 1250 lb per square inch and 950 deg. Fah., and 1500 lb per square inch and 1050 deg. Fah. respectively.

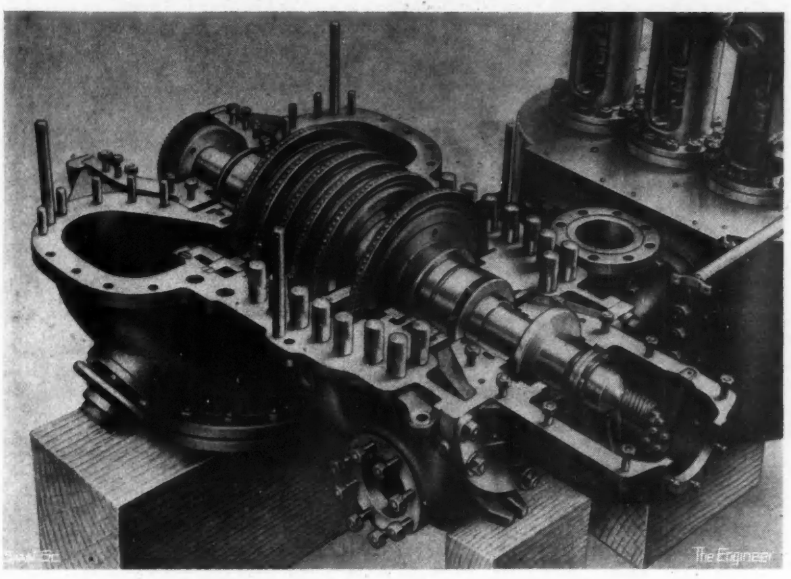
Another hydrogen-cooled unit, designed for the extra high steam conditions of 1500 lb per square inch and 1050 deg. Fah. will be the 60-MW English Electric set recently ordered for the new Drakelow power station. Finally, we learn that designs are in hand for the high-temperature, high-pressure, hydrogen-cooled, 60-MW B.T.-H. sets, which are proposed for Meaford "B" power station; the initial steam conditions will be 1500 lb per square inch and 1050 deg. Fah.



60-MW HYDROGEN-COOLED ALTERNATOR FOR LITTLEBROOK "B" POWER STATION

HYDROGEN COOLING

We have already mentioned hydrogen cooling in passing, and further reference to this subject is justified by the fact that, although hydrogen-cooled sets are by no means a novelty in the U.S.A., the first 60-MW hydrogen-cooled set at Littlebrook "B" power station marks an innovation in British practice. A full description of this set was published in our issue of June 11, 1948, and the illustration reproduced herewith shows the alternator on the test-bed at the Trafford Park works of the Metropolitan-Vickers Electrical Company, Ltd. The well-known advantages of hydrogen, compared with air, as a cooling medium, were amply demonstrated in tests carried out at the end of May, when the temperature rise, on a load of 60,000kVA was shown to be approximately 60 per cent less when operating in hydrogen at 15 lb per square inch than when cooled by air under the same conditions. With a load of 75,000kVA and cooling by hydrogen at 0·5 lb per square inch, the temperature rise was 20 per cent less than it was when air at the same pressure was used for cooling, with the load reduced to 60,000kVA. At the same time the effect of density on windage losses was indicated by an increase in efficiency; using the method of summation of losses, the efficiency at 60,000kW, 0·8 power factor, was shown to be 98·5 per cent when hydrogen cooled, compared with 97·7 per cent when air cooled.



1250-KW AXIAL FLOW BACK-PRESSURE TURBINE

Referring to the illustration, the outer casing of the alternator is designed to house four tubed gas cooler units, one of which is shown, in a partly completed state, on the extreme left of the view. The stator, complete with gas coolers, weighs 151 tons. The alternator has bracket-type bearings, and a specially strengthened frame to support the heavy brackets which carry the whole weight of the 32-ton rotor.

NEW RANGE OF AXIAL FLOW TURBINES

An interesting development, of which full details are not yet available, was the completion, by the Brush Electrical Engineering Company, Ltd., of the first of a new range of axial flow turbines. This particular unit was supplied to the order of Kveldulfer, Ltd., for a herring factory in Iceland. The turbine is a back-pressure unit, the exhaust steam being used in the factory for various processes involved in the production of herring oil.

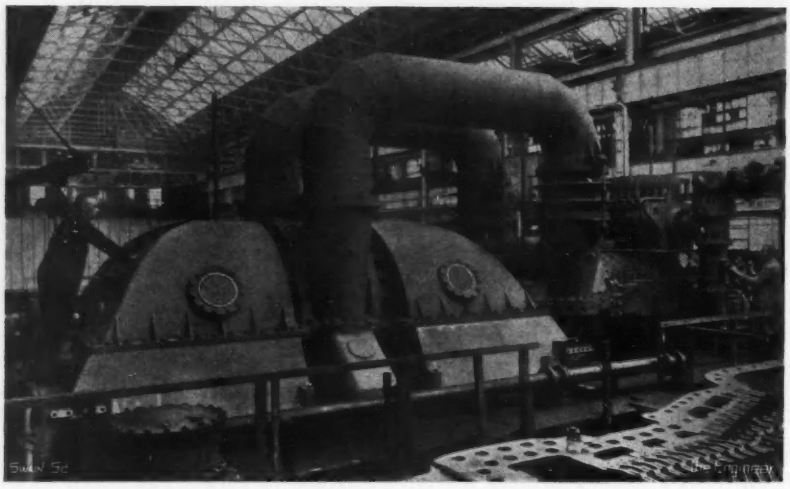
Steam is supplied to the turbine at a pressure of 385 lb per square inch and a temperature of 610 deg. Fah., and the exhaust pressure is 80 lb per square inch for distribution throughout the factory for process work.

One of our illustrations gives a general view of the turbine with the top half of

* Joint Meeting, Institution of Mechanical Engineers and Institution of Electrical Engineers, London, Oct. 29, 1948.

the casing removed to show the rotor. The turbine is a high-speed unit, which runs at 10,000 r.p.m. and drives the 1250-kW alternator at 1500 r.p.m. through reduction gearing.

Generation is at 6kV, three-phase, 50 c/s, the voltage being stepped down to 220V for distribution in the factory. In addition to supplying the turbo-alternator for this installation, the Brush Electrical Engineering Company, Ltd., provided the associated transformers and the high and low-tension switchgear.



30-MW Turbo-Alternator with Fabricated L.P. Cylinder

Fabricated Turbine Exhaust Casings

Though fundamental changes in the design of steam turbines and alternators are rare, progress as measured by the sum of a number of detailed improvements is a more or less continuous process. A few developments of this kind which came into some prominence in 1948 are briefly referred to below, as typifying the contribution made by relatively minor advances to progress in design and operation generally.

An interesting development in manufacturing technique is the application of fabricated (welded steel) construction to turbine-exhaust casings. This project was investigated initially by the British Thomson-Houston Company, Ltd., in the late 1930s, but the idea was not pursued then, because manufacturing difficulties and probable cost increases were foreseen. More recently, however, manpower and material shortages in the foundry caused fabrication of turbine-exhaust casings to be viewed in a new light.

Experience now shows that there is no basis for the objections originally anticipated, provided, of course, that the design and manufacturing technique are closely controlled. For instance, distortion after welding proves to be far less than was feared; to reduce internal stresses in the material, the whole structure is carefully annealed when completed.

Considerable economies in material and machining can result from this form of construction, pre-machining and wastage being reduced to a minimum by using the correct size of plate and bar material. The result of applying this technique to the top and bottom halves of a low-pressure cylinder can be seen in the accompanying illustration, which shows the turbine of the 30-MW, 3000 r.p.m. turbo-alternator for Walsall on test in the Rugby works of the British Thomson-Houston Company.

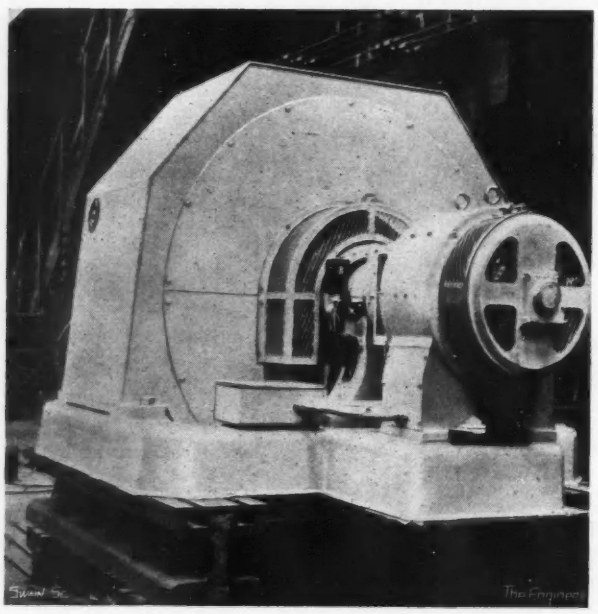
Turbine Supervisory Equipment

Increasing use is being made of turbine supervisory equipment, particularly during the running-up and shutting-down periods, which are characteristic of shift-working. Supervisory equipment designed to indicate and record (*a*) differential axial expansion between rotor and cylinder and (*b*) shaft eccentricity was exhibited by the Metropolitan-Vickers Electrical Company, Ltd., at last year's British Industries Fair, Castle Bromwich, and was described in our issue of May 14th. Briefly, this equipment makes use of suitably disposed electro-magnetic detecting elements to measure axial expansion and shaft eccentricity, the appropriate measurements being shown separately on calibrated indicating and recording instruments. In the form exhibited, the instruments for both measurements—axial expansion and shaft expansion—were conveniently grouped on the front of a resiliently-mounted sheet-steel cubicle.

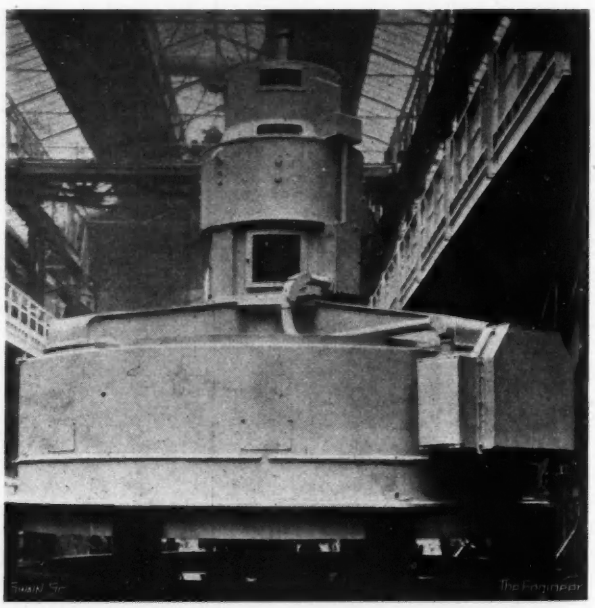
A somewhat similar device is embodied in the turbines at the new Kingston power station, except that, in this installation, the instruments for recording the high-pressure turbine-shaft eccentricity and the relative axial expansion are mounted on the central instrument panel, which is common to each pair of turbines.

Another interesting point about the Kingston sets is the use of load suppression equipment with each turbine. The load suppressor ensures that a fall in vacuum causes a reduction of steam flow, and that, if the vacuum falls below a predetermined level, the machine is shut down.

Apart from technical developments, such as those we have indicated, the main effort of British manufacturers during 1948 was directed towards an increase in output, especially of the statutory "standard" 60-MW and 30-MW sets. In particular, the Metropolitan-Vickers Electrical Company, Ltd., claims to have produced a compact arrangement leading to economies in the use of steel and a reduction in building costs;

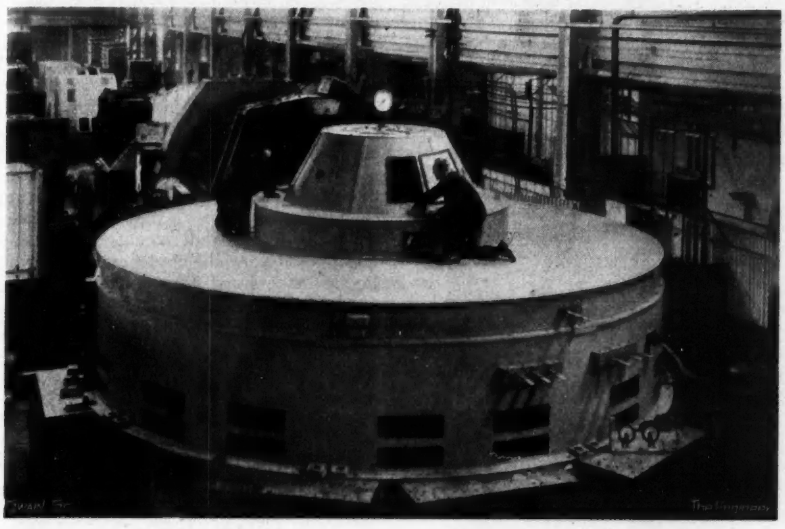


500-kW Horizontal Shaft Alternator for Lochalsh



417-kW Vertical Water Wheel Alternator for Morar

the steel sections used in foundation blocks for generating sets is reduced to the minimum, making due allowance for the strength and vibration damping properties of concrete.



18,900-KVA VERTICAL WATER WHEEL ALTERNATOR FOR CLUNIE POWER STATION

To meet the demand for generating plant, a number of British firms are engaged in expanding their manufacturing facilities. Extensions which are being carried out by the turbine department of Metropolitan-Vickers Electrical Company, Ltd., will raise the production capacity to three times the pre-war figure. In the meantime, during 1948, this company succeeded in despatching from its Trafford Park works twenty-seven turbo-generator units, ranging in size from a house set of 1500kW to main generators of 60MW capacity, nearly 50 per cent of the year's production being for export, including two 25-MW sets, generating at 22kV, for South Fremantle.

Manufacturing capacity at the Heaton Works of C. A. Parsons and Co., Ltd., was substantially increased by the completion of a new turbo-alternator shop, which was described in our issue of December 3, 1948 an illustration of the shop under construction was reproduced on one of our Supplement pages two weeks ago. Among the Parsons turbo-alternators completed for export were the second 40-MW set for Congella, South Africa, and three machines for Australia—a 25-MW set for Brisbane, a 30-MW set for Adelaide, and a 30-MW set for Melbourne.

Hydro-Electric Plant

As indicated two weeks ago in the article on "Civil Engineering in 1948," a number of the North of Scotland Hydro-Electric Board's schemes are reaching maturity. The Lochalsh and Morar installations in particular came into operation in December. They are intended exclusively for the benefit of the Highlands and, as such, their comparatively small output capacities bear no relation to their true importance. Both power stations are semi-attended and a variety of fault protection devices are incorporated in the control system.

One of the accompanying illustrations shows a view of the 500-kW horizontal shaft alternator for Lochalsh, reproduced from a photograph taken in the works of the manufacturer, Bruce Peebles, Ltd. Another illustration shows the 417-kW Bruce Peebles vertical water-wheel alternator for Morar.

During the year the first of the three 18,900-kVA B.T.-H. vertical water-wheel alternators was shipped for Clunie power station. This machine is shown, in one of our illustrations, assembled on the makers' test bed.

Among the interesting contracts placed by the Board was the order for a horizontal water-wheel alternator for Lawers power station. This B.T.-H. alternator, which is to be driven by two overhung Pelton wheels, will be rated at 29,500kVA, 0·8 power factor, 375 r.p.m., generating at 11kV, three-phase, 50c/s. An unusual aspect of the design of this machine is that, to keep the axial length as short as possible, the main exciter will be housed in the main alternator frame.

During the year the same company accepted an important overseas order, involving turbines, alternators, transformers, switchgear and auxiliaries for the Los Peares power station of Fuerzas Electricas del Noroeste, S.A., Spain. This power station will contain three vertical alternators, each rated at 62,400kVA, 0·85 power factor, 214 r.p.m., generating at 11kV, three-phase, 50c/s and driven by 72,800 b.h.p. Francis turbines, supplied by Boving and Co., Ltd. Each alternator will be solidly connected to a bank of single-phase water-cooled transformers, stepping the voltage up to 132kV for main switching at an outdoor sub-station remotely controlled from the power station.

For the Owen Falls hydro-electric scheme, Uganda, four B.T.-H. vertical water-wheel alternators have been ordered, each being rated at 16,700kVA, 0·9 power factor, 150 r.p.m.

Diesel-Electric Generators

While the Owen Falls development may be expected to provide long-term benefits, East Africa lacks developed coal and must turn to oil-engine plant for her more immediate power needs. Accordingly, during 1948, the East African Power and Lighting Company placed an order for English Electric diesel engine-driven generating sets to be installed in six power stations at Nairobi, Mombasa Island, Kisumu, Mwanza, Tabora and Iringa. In all, twelve engine and alternator sets are involved, the equipments ranging in size from three 1600 b.h.p., sixteen-cylinder, turbo-pressure-charged V-engines, driving 6·6-kV alternators at Nairobi and Mombasa Island, to three 165 b.h.p., three-cylinder, naturally-aspirated engines, driving 3·3-kV alternators at Iringa. At Kisumu, Mwanza and Tabora the sets will embody eight, seven and five-cylinder engines, respectively, and of these only the first will be turbo-pressure-charged.

(*To be continued*)

Shipbuilding and Marine Engineering in 1948

No. III—(*Continued from page 61, January 14th*)

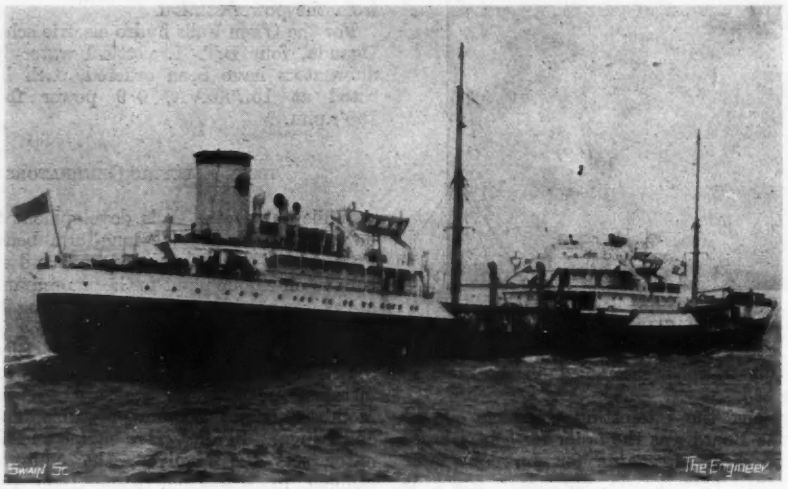
Electrically Driven Oil Tankers

AMONG the electrically driven oil tankers which have entered service during the year and are under construction, an outstanding example was the single-screw oil tanker "Auris," illustrated herewith, which was constructed by Hawthorn Leslie and Co., Ltd., of Hebburn-on-Tyne, for the service of the Anglo-Saxon Petroleum Company, Ltd. Not only has a.c. propulsion been chosen but the Hawthorn-Sulzer engines driving the alternators are specially equipped to burn fuel of boiler-oil quality, and thus take a stage further experiments begun by Mr. John Lamb with a Hawthorn-Werkspoor engine, continued with success in the motor tanker "Auricula." Another oil tanker for the same owners by Swan Hunter and Wigham Richardson, Ltd., of Wallsend, the "Hyalina," is equipped with B.T.H. turbo-electric machinery and Babcock and Wilcox water-tube boilers specially designed to burn low-grade asphalt. This new ship will play an important part in the practical research work which is being undertaken by the Shell and other groups of oil companies, on the use of low-grade fuels.

The "Auris" is of further interest as she has been chosen, on the completion of her experimental service, for the installation of the B.T.H. gas turbine unit of 1200 s.h.p., which will replace one of the engines. Later a 6500 s.h.p. gas turbine will be installed in one of the company's larger tankers.

The principal dimensions of the "Auris" are as follows: length overall 482ft 6in, breadth moulded 59ft, depth moulded to upper deck 34ft 10in, and deadweight carrying capacity 12,000 tons. The machinery is placed aft and electric welding was largely employed in the building of the hull. The accommodation for the officers and crew is of the company's usual high standard. The engines driving the four alternators are the Hawthorn-Sulzer four-stroke units, each designed to develop with Büchi superchargers, 1100 b.h.p. at 375 r.p.m. They have eight-cylinders, with a bore of 340mm and a stroke of 480mm. The four alternators are rated at 830kVA each, the current generated being three-phase, fifty cycles, at 1600V.

The main propelling motor has a designed output of 3750 s.h.p. and the propeller speed is 120 r.p.m. The auxiliary plant using alternating current is supplied at a voltage of 400 from two transformers. In the auxiliary generating plant provision is made for 110-V direct current for the centrifugal purifiers and other auxiliary machinery. Steam, which is required for the deck machinery, is raised in two cylindrical boilers, arranged on a flat above the main propelling motor, which, at sea, is arranged to utilise the exhaust gases from three of the engines. The fourth engine exhausts directly to the funnel as it may be employed to investigate the running on various classes of oil fuel. All the electrical equipment, including the alternators, the propelling motor, the switchboard and control cubicle as well as auxiliary electrical motors and equipment, was supplied by the British Thomson-Houston Company, Ltd., of Rugby.



ELECTRICALLY PROPELLED TANKER "AURIS"

In addition to the usual centrifugal purifiers for the lubricating oil, special settling tanks and a fuel purifier and a clarifier are provided.

The performance of the "Auris," no less than that of the "Auricula," will be awaited with interest by all interested in the use of heavy fuel oils.

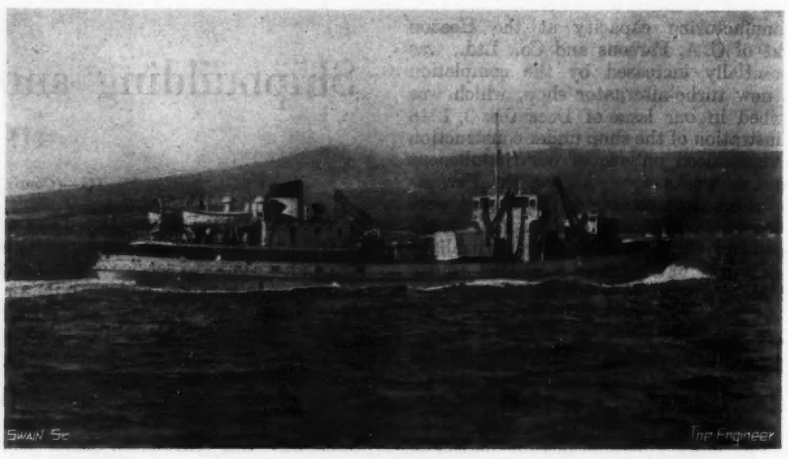
Among the dredgers completed during the year were two for the Mersey Docks and Harbour Board, constructed by Ferguson Brothers (Port Glasgow), Ltd. The first of these ships, "Mersey No. 26," completed successful trials in October and was delivered to her owners. A view of the dredger is reproduced herewith. She is a twin-screw ship propelled by diesel-electric machinery operating on the controlled constant-current system, which is employed for both propulsion and the deck machinery. The electrical equipment was supplied by the Metropolitan-Vickers Electrical Company, Ltd. The principal dimensions of "Mersey 26" and "Mersey 27" are: length overall, 237ft, breadth moulded 40ft 6in, and depth moulded 17ft 3in. The loaded draught is 14ft 3in and the hopper capacity 1350 tons, or 30,470 cubic feet. The propelling machinery comprises three Davey Paxman twelve-cylinder, pressure-charged engines, each engine having two banks of cylinders with a bore of 9½in and a stroke of 12in. The twelve-hour rating of these units is 780 b.h.p. at 520 r.p.m. The three generating sets each have a designed output of 450kW, and a 62½-kW auxiliary generator is arranged in tandem with each main generator. Each of the twin propelling motors has an output of 836 s.h.p. at 135 r.p.m., and there are two Metadyne sets for excitation. The generating sets also provide power for the three Priestman dredging cranes, the deck winches by Stothert and Pitt, and the Hastie electro-hydraulic steering gear. These dredgers, as our illustration clearly shows, have a navigating bridge just forward of 'midships, with two-tier deck houses aft. On trial a speed of 12·2 knots was attained with three engines and 11·27 knots with two engines.

Among the marine machinery constructed during the year a notable installation was that designed and built by John Brown and Co., Ltd., at Clydebank, for the Cunard White Star liner "Caronia," which recently completed a most successful maiden voyage to New York. The machinery is arranged in four compartments in order forward to aft, the auxiliary machinery room, the turbo-generator room, the boiler-room and the engine-room. The twin screws are each driven by an independent set of geared turbines of the Parsons impulse reaction type, which are designed to utilise steam between the pressure limits of 550 lb per square inch, and 0·49 lb per square inch absolute, with an initial temperature of 780 deg. Fah. Each set comprises three turbines, one high pressure, one intermediate pressure, and one low pressure. Provision is made to isolate the turbines in the event of an emergency. The gearing is double reduction for the high-pressure turbine and single reduction for the intermediate and the low-pressure turbines. A gland-evacuation system is fitted. The condensers work on a closed feed system with feed heating, and the machinery is controlled from the main starting platform at floor level at the forward end of the engine-room.

The boiler plant consists of six side-fired, five-drum Yarrow boilers, one of the drums in each boiler serving as a superheater header.

A view in the boiler-room was included in last week's Special Supplement. Four of the boilers each have a normal evaporation of 86,000 lb of steam per hour and two smaller boilers 50,000 lb. Steam is supplied at 600 lb pressure and 800 deg. Fah. Arrangements are made to control the superheat by means of coupled dampers in the uptakes. One Howden-Ljungström rotary air preheater is fitted to each boiler, and one Howden wet type dust collector is provided for each boiler uptake and is situated in the funnel. For the engine boiler and turbo-generator rooms there is a ventilation system, from a double ceiling in the way of each of these rooms. Cold air is delivered at appropriate points, anemostats being used where needed. The cool air is finally exhausted along with the main ventilation air from the respective compartments.

The low-pressure auxiliary steam and the electricity requirements throughout the ship are supplied by four turbo-generators designed and built by W. H. Allen Sons and Co., Ltd., Bedford. The units are self-contained, geared, pass-out generators, each designed for a normal full load of 1100kW at 225V. The overload capacity of each set is 10 per cent continuously, 25 per cent for two hours, and 50 per cent for five minutes. Each set is arranged to pass out up to 15,000 lb of steam per hour at a gauge pressure of 60 lb per square inch. This installation is of particular interest as it is, so far as is known, the first instance of using pass-out turbo-generators to supply steam to galleys and other low-pressure auxiliary services. The lighting of the ship requires over 10,000 lamps. In addition, there are about 1300 fluorescent tubes, all of which were supplied by the B.T.H. Company, the lighting schemes being worked out in collaboration with the architects, Messrs. McInnes Gardner and Partners.



MERSEY DREDGER No. 26

Lloyd's Register Shipbuilding Returns

THE returns issued by Lloyd's Register of Shipping for the quarter ended December 31st, show that in Great Britain and Northern Ireland the steam and motor merchant ships under construction totalled 2,114,730 gross tons, a figure which was 94,269 tons below that of the preceding quarter. It is pointed out that the tonnage of ships under construction continues to be influenced by the delays which the present circumstances are imposing upon the completion of ships, and the consequent prolongation of the time required for building them. Shipping upon which work had been suspended amounted to only 1180 tons. There was an increase in the amount of tonnage intended for registration abroad, which has risen progressively. In the December quarter thirty-three ships intended for registration abroad were begun, representing a total of 154,044 tons. The tonnage of steam and motor vessels under construction abroad, at the end of December, was 2,026,086 gross tons, which is 31,212 tons more than that recorded at the end of September last. It is noted that no figures are recorded for shipbuilding in Germany, Japan and Russia. The leading countries abroad were France, America, Sweden, Holland, Italy, the British Dominions and Denmark in that order. In many cases of tonnage being built abroad about one-third is intended for registration elsewhere than in the country of build or for sale. The total tonnage of steamers and motorships under construction in the world, apart from the three countries excluded as mentioned above, amounted to 4,140,816 gross tons, of which 51·1 per cent is being built in Great Britain and in Northern Ireland, and 48·9 per cent abroad. Of the total number of ships under construction in Great Britain and Northern Ireland at the end of December, 879,428 tons were steamers and 1,235,302 tons were motor vessels. At the same date similar figures for abroad were steamers 771,336 tons and motorships 1,254,750 tons. Steam and motor oil tankers of 1000 gross tons and upwards amounted to a world total of 129 vessels, aggregating 1,387,654 gross tons; of these thirty-three are steam and ninety-six motor tankers. Of the 2,565,162 gross tons in hand throughout the world at the end of December, 61·9 per cent are being built under the inspection of Lloyd's Register of Shipping.

Codes of Practice

The Codes of Practice Committee for Civil Engineering, Public Works and Building and Constructional Work is under the ægis of the Ministry of Works. Codes are issued on behalf of the Committee by the British Standards Institution, 24–28, Victoria Street, London, S.W.1.

LOAD-BEARING WALLS (STRUCTURAL)

Code 111. This code was previously issued as a draft for comment and has been revised in the light of comments received by a committee convened by the Institution of Structural Engineers.

The Code is one of a group on load-bearing superstructure and a companion document to Code 112: "Structural Use of Timber in Building"; Code 113: "Structural Use of Steel in Building"; Code 114: "Structural Use of Normal Reinforced Concrete in Building."

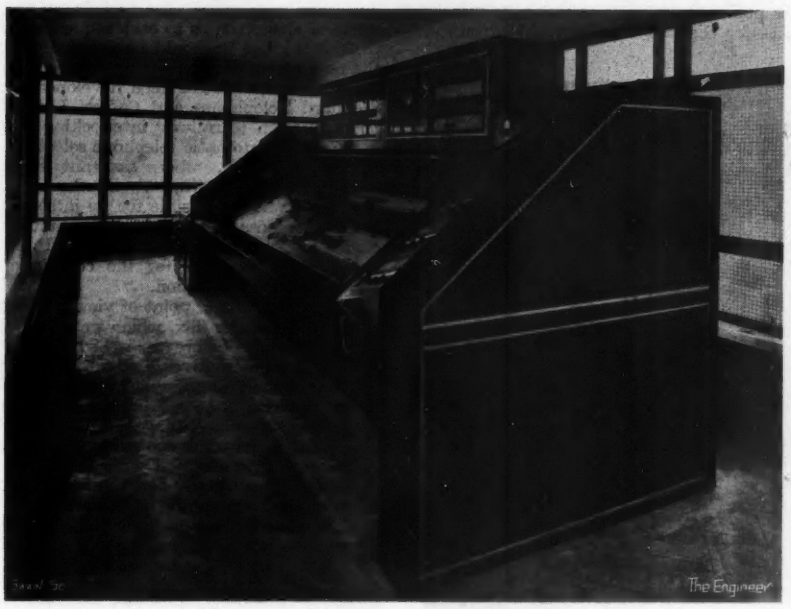
The main Code gives structural recommendations relating to load-bearing walls of masonry (including brickwork) and cast in situ concrete. Recommendations are made regarding materials to be used, maximum permissible stresses and methods of design and construction. It deals with the design of walls based on the load to be carried by the wall, in conjunction with certain specified permissible stresses.

Terms used in the Code are defined and extensive information is given on the quality of materials. Guidance is afforded on such design considerations as loading, wall thicknesses, lateral support, modifications of effective thickness, due to intersecting walls and piers, and cavity walls. Methods of determining the compressive strength of structural units and the water absorption of bricks, strength tests for alternative materials, and methods of construction, and the requirements to which hydraulic and quick-hardening limes should conform, are described in appendices.

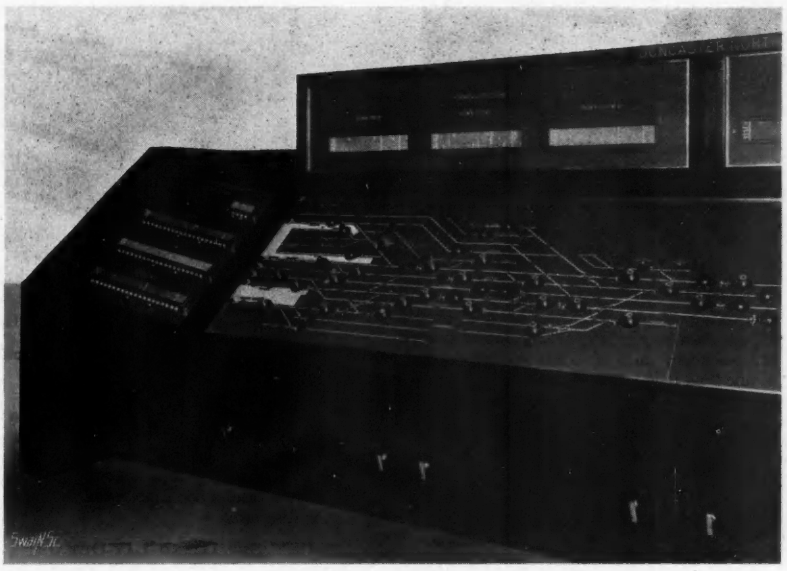
Three sub-codes deal with load-bearing walls of masonry, including brickwork (unreinforced); masonry, including brickwork (unreinforced), and concrete cast in situ. Price 5s.

Re-Signalling at Doncaster

THE opening of the new South Box at Doncaster, Eastern Region, on Sunday, January 9, 1949, marks yet another notable stage in the development of electric interlocking practice in Great Britain. The key position of Doncaster, lying at the junction of the West Riding lines, the important cross-country route from Manchester to Grimsby, the line to Hull, and the old Great Northern and Great Eastern Joint line through Lincoln to the eastern counties—together with the East Coast route from London to Scotland—naturally renders its traffic facilities of great interest. The rearrangement of the track lay-out, with the partial reconstruction of the station itself, has been accompanied by complete resignalling, with electric interlocking, colour-light signals, the latest type of long-range junction indicators, and control panels. Although there is a good deal of through running, much of the local movement at the north end of the station is quite independent of the south end, and this characteristic of the traffic working was a major consideration in the decision to have separate signal-boxes for the two ends of the station. The change-over from manual to power signalling is being made in two stages; as previously mentioned, the South Box was opened first, on January 9th, and the new North Box will be brought into service very shortly.



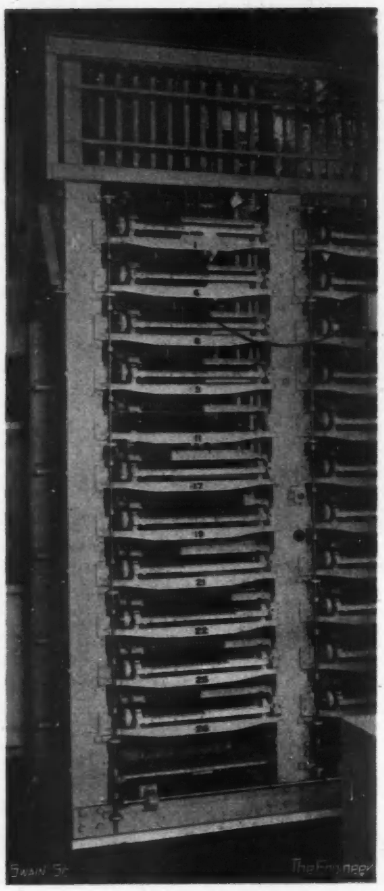
SOUTH BOX INTERIOR AND CONTROL PANEL



CONTROL PANEL IN DONCASTER NORTH BOX

While the signalling itself is of considerable interest in view of some special traffic facilities that have to be provided, it is the design of the interlocking apparatus in conjunction with the control panels that constitutes so marked a departure from previous practice. For each

pair of diverging points there is a single rotary switch at the geographical position of the points in question on the panel diagram. These switches can be rotated to a number of positions corresponding to the number of routes to which the points concerned can read. After the switch has been turned to the desired route the setting up of that route is initiated by the depressing of a plunger integral with the switch itself. This is a novel arrangement in itself, but whereas the interlocking between the various routes has, in previous panel installations, been accomplished through the agency of relays, proving that the requisite conditions—lie of other points, occupancy of track circuits, and so on—for the safe setting up of a route are



INTERLOCKING EQUIPMENT

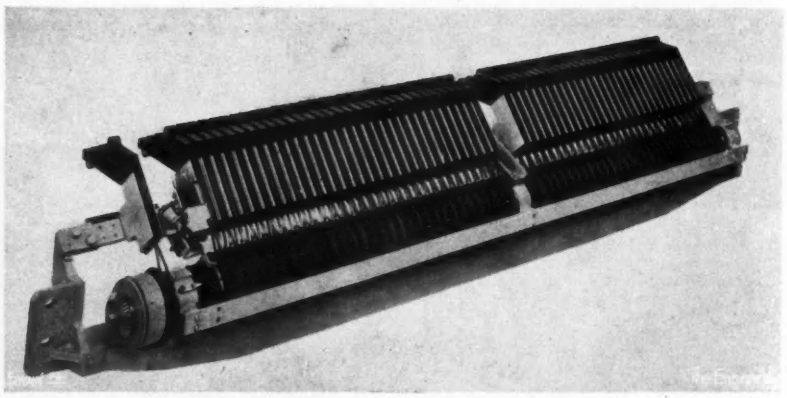
fulfilled, at Doncaster rotary sequence switches are used for interlocking purposes. In this respect, the new installation is the first of its kind anywhere in the world.

SEQUENCE SWITCH INTERLOCKING

The rotary sequence switches are motor driven, and can be stopped in any one of twelve radial positions; one of these is the normal, or "home" as it is termed, and the others are allotted to eleven signal routes, all of which refer to movements which would conflict with one another. The interlocking between the eleven routes allotted to one rotary sequence switch is thus effected physically, since the switch can only be in one route position at a time. For convenience in lay-out only one motor is provided to drive all the sequence switches in the interlocking; this is effected through a system of shafting and bevel gear drives. The turning of one of the route switches on the panel, and the depressing of the initiating button on that switch operates a switch control relay—that is, of course, if no conflicting route is set up. The switch control relay energises a clutch which connects the appropriate sequence switch shaft to the motor drive, and then the shaft rotates until it reaches the required route position. A proving relay is provided to check that the switch has stopped in the position corresponding to the route called for by the panel switch. The route selection having been thus obtained, and checked, the points are set, and the clearing of the appropriate signal and route indicator is controlled through the contacts of point indication relays of the usual signalling type. As a result of the physical interlocking effected by their sequence switches the number of units required is not large. The 174 routes in the Doncaster South Box panel are carried on thirty-nine switches. It will be appreciated that due to the nature of the track lay-out it is not possible in every case to allocate the full quota of eleven routes to each sequence switch.

At this stage it should be pointed out that the novel form of interlocking equipment used in this installation has been developed by the Standard Telephones and Cables, Ltd. It is an adaptation to railway interlocking duty of one form of automatic telephone selector. Mr. A. E. Tattersall, when assistant engineer, signals and telegraphs, Southern Area, L.N.E.R., was responsible for its introduction, and Mr. A. Moss, signal and telecommunications engineer, Eastern Region, British Railways, has been responsible for the completion of the Doncaster installation.

From an operating point of view, the control panel in the South Box, which we were able to inspect shortly before it was brought into service, is an attractively designed instrument. The illuminated diagram and the control panel proper, which can be seen in one of the photographs we reproduce, form the central sloping face, and on the wings are mounted the stencil indications in connection with the telephones by which shunters can communicate with the signalmen on the control panel, and there also are mounted the stencil indications, which are illuminated when enginemen use the telephones at signal posts. The indicators for the train description apparatus are mounted above the illuminated diagram, but the keys for transmission of the description of trains are mounted on a narrow keyboard below and in front of the diagram. To obviate any chance of a train description transmitting key being inadvertently operated, the plungers are contained in a recessed housing. As usual nowadays, the track circuit indication lamps are normally out, and light up to show the presence of a train. The lie of each pair of points is constantly shown; typical indications are illustrated in the accompanying diagram.



INTERLOCKING SEQUENCE SWITCH]

SIGNALLING LAY-OUT

Turning now to the signalling in general, in common with all power signalling, and particularly those installations where route working is in force, a considerable saving in lever movements is effected at Doncaster. During the busy period between 6 p.m. and 9 p.m. the operation of the normal timetable involves approximately 134 train movements. At one mechanical signal-box where two men were on duty, 1294 lever movements were necessary during this period—that is, one every 8·5 seconds. With the new lay-out the same 134 train movements will require no more than 486 panel-switch movements, or one every 23 seconds. The physical work is eliminated, and the men have time to devote their attention wholly to the efficient regulation of traffic. When the Doncaster installation is complete, and both North and South boxes are in service, a total of six mechanical boxes will have been replaced.

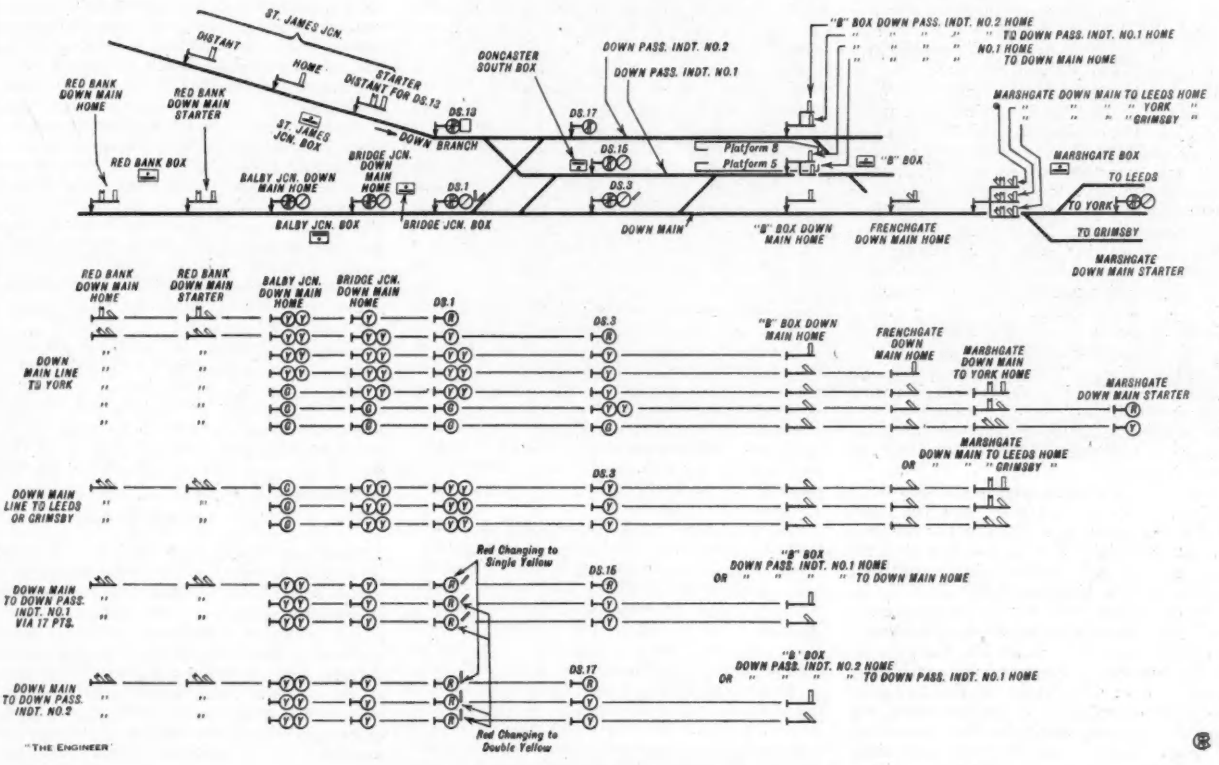
The main running signals are of the colour-light type, and the majority of those relating to passenger movements display four indications. The signal units consist of three-position "searchlights," with a single yellow light unit mounted above. The searchlight signal relays are operated at 12V and have 6-V, 6–9-W independent double-filament lamps, in which the auxiliary filament is brought into use automatically in the event of failure of the main filament. Signals controlling main line running junctions are equipped with long-range position-light junction indicators, by which the direction to be taken at a turn-out is conveyed to the driver by a series of five white lights. With these indicators a form of protection against lamp failure is provided. If more than two of the five lamps should burn out the signal itself will not clear. For low-speed movements, as, for example, on the down coal and down goods independent lines, the route indicators are of the theatre sign, or multiple-lamp type, and display a 15in letter or figure. For starting signals in bay platforms, and for movements to "no-block" lines, multi-aspect colour-light signals of shorter range than the main running signals are used. Shunting and subsidiary signals are of the banner type, solenoid operated on 110-V d.c., and floodlighted at night.

SPECIAL SIGNALLING ARRANGEMENTS

Owing to the intensive working at certain hours of the day it has been necessary to allow movements to be made up to a signal while its overlap distance is occupied, or while a route is set that would foul the overlap. In such cases, to safeguard against the chance of an overrun the clearing of the signal in rear is delayed until the train has approached to within approximately 200 yards of that signal. Once an unrestricted clear signal has been given no movement that would foul the overlap of the signal ahead can be made. Movements between the North and South signal-boxes are controlled by acceptance switches in the forward box; of these switches, those for "right direction" movements have "free" and "restricted" positions, depending upon whether the overlap is clear or not. Due to the complicated nature of the track lay-out in the approaches to the station, on both north and south sides, the signals require to be spaced at relatively short intervals. Even then with four-aspect signals there is not full braking distance at the maximum speed permitted to non-stopping trains between some signals and that next but one ahead—the normal interval

between the "double yellow" indication and the "red." In such cases it has been arranged for the "single yellow" to be preceded by two, and in some cases three, successive signals displaying "double yellow."

Similar arrangements were found necessary when the south approach to Darlington was resignalled in 1939. The details of the aspects displayed in the new signalling at Doncaster South may be studied from the accompanying diagram, in which the aspects for the down main line signals are shown. This diagram refers to the interim arrangements between the opening of the South and North boxes, for it will be seen that the signals at the north end of the station are still semaphores. To take a particular example: with Frenchgate down main home "on," the first warning would be received with Balby Junction down main home showing "double yellow"; two more "double yellows" follow, and then a single yellow at signal DS3. This diagram only relates to the down lines, and although the down branch line coming in from Mexborough is shown, the aspects shown by the branch signals are not included. The home signal DS. 13 is one of those fitted with the theatre sign type of route indicator.


ST. JAMES JCN.
DISTANT
HOME
STARTER
DISTANT FOR DS.13
RED BANK DOWN MAIN HOME
RED BANK DOWN MAIN STARTER
ST. JAMES JCN. BOX
DOWN BRANCH
DS.13
DS.17
DONCASTER SOUTH BOX
DOWN PASS. INDT. NO.2
DOWN PASS. INDT. NO.1
"B" BOX DOWN PASS. INDT. NO.2 HOME
" " " " " TO DOWN PASS. INDT. NO.1 HOME
" " " " NO.1 HOME TO DOWN MAIN HOME
MARSHGATE DOWN MAIN TO LEEDS HOME
" " " " YORK "
" " " " GRIMSBY "
MARSHGATE BOX
TO LEEDS
TO YORK
TO GRIMSBY
MARSHGATE DOWN MAIN STARTER
RED BANK BOX
BALBY JCN. DOWN MAIN HOME
BRIDGE JCN. DOWN MAIN HOME
DS.15
DS.1
DS.3
Platform 6
Platform 5
"B" BOX
BALBY JCN. BOX
BRIDGE JCN. BOX
DOWN MAIN
"B" BOX DOWN MAIN HOME
FRENCHGATE DOWN MAIN HOME
DOWN MAIN LINE TO YORK
MARSHGATE DOWN MAIN TO YORK HOME
DOWN MAIN LINE TO LEEDS OR GRIMSBY
OR " " " GRIMSBY "
DOWN MAIN TO DOWN PASS. INDT. NO.1 VIA 17 PTS.
Red Changing to Single Yellow
DS.16
"B" BOX DOWN PASS. INDT. NO.1 HOME
OR " " " " TO DOWN MAIN HOME
DOWN MAIN TO DOWN PASS. INDT. NO.2
DS.17
"B" BOX DOWN PASS. INDT. NO.2 HOME
OR " " " " TO DOWN PASS. INDT. NO.1 HOME
Red Changing to Double Yellow
"THE ENGINEER"

DONCASTER SOUTH. ASPECT DIAGRAM. DOWN LINES

Where it was necessary to carry them underground the cables were run in asbestos-cement conduit, set in concrete. The leads from location cases to apparatus are protected "ITE" class cables buried direct in the ground. Relay room and location wiring is carried out with flameproof "ITE" wire, with asbestos-covered cables for the power circuits.

Some Installation Details

Welded steel apparatus cases are used to house all external equipment. In the lower portion of these cases terminal blocks with disconnection links were provided for connection between the main cables and the wiring to apparatus in or adjacent to the location case. This method of connection enabled the cases to be shop wired, thus avoiding delays due to bad weather or difficult site connections. The transformers and lamp-proving relays for the colour-light signals are mounted in small welded steel cabinets attached to the signal structure, thus reducing the number of cores between the signal and location case, and minimising the length of conductor in the lamp-proving circuit. The main cables, which are oil-impregnated, paper insulated, lead sheathed and protected, run overground wherever possible in open wooden troughing carried on concrete stakes.

Train Describers and Telephones

The train-description apparatus has been designed to form part of the control panels, and the general lay-out will be apparent from the accompanying engravings. Owing to the complexity of traffic at Doncaster it was decided to use manual transmission and cancellation of train descriptions. The method of working, for example, on the down main line is: the description of a train is transmitted to Doncaster South by the last of the outlying boxes at which ordinary block working is in operation, namely, Bridge Junction. South Box, on receiving this description, can retransmit to North Box, on any line that is available to the train, by the operation of one push button. Trains leaving Doncaster are described forward to the first outlying box by block bell.

The numerous types of trains and destinations to be dealt with made it necessary to use a three-unit code, for train descriptions, to avoid an excessive number of indications to be displayed. At Doncaster, the description of a train is made up thus:

(1) The figure denoting the standard block bell code by which it would normally be described in manual block working.

(2) A letter, or letters, indicating the destination.

(3) The letters S or T indicating whether the train is booked to stop in the station or to run through. Thus, an express passenger train to Leeds, stopping at Doncaster, would be described as 4 L S. A simple form of describer, giving destinations only, is provided for the goods lines between North and South boxes, and supplementary describers showing the destination of each one of a group of light engines are provided between Bridge Junction and Doncaster South Box.

A comprehensive system of telephones is installed, for communication between enginemen, yard and station staff and the signalmen at the control panel. A microphone and loudspeaker are provided which the signalmen can use instead of the hand set, if they so desire, while operating the panel.

Power Supply

A 400-V, three-phase supply is taken from the sub-station in the Doncaster Locomotive and Carriage Works, and, at a power-house near the South Signal-box, is converted for signalling purposes to 660-V, two-phase, by duplicate Scott connected transformers. A 25-kVA diesel-driven generator set is provided as a stand-by; in the event of any failure of the main supply this set is started automatically and is capable of taking full load within ten seconds of the failure. The stand-by set is equipped with synchronising gear to enable the load to be transferred back to the mains without further interruption. A sixty-five-cell, 250 ampere-hour lead-acid battery is provided for supplying the direct current operating the electric point motors and the solenoid-worked subsidiary signals. This battery is charged by metal rectifiers, and further rectifiers provide the d.c. supply for interlocking and control circuits, train describers, telephones, and so on. The track circuits are direct current, with rectifier feed.

B.T.H. Summer School in Electrical Engineering, 1948.—The British Thomson-Houston Company has published, in a limited edition, the proceedings of the B.T.H. Summer School held at Rugby in July, 1948. This well-illustrated book contains a complete record of the addresses and twenty-six lectures, which covered a wide diversity of subjects in the field of electrical engineering, including the properties of magnetic sheet steel, high-voltage transformer insulation design, high-power pulse generation, bridge measurement at large kVA, high-speed analogue computing and problems in the development of electric discharge and fluorescent lamps.

Some Speculations on the Future of Structural Engineering*

By I. LEVIN, M.I.C.E., M.I. Mech.E., M.I. Struct. E.

THE art of structural engineering is of very ancient origin but the science is a product of modern civilisation. It is in the application of science to design and materials that the remarkable progress of recent years has been greatest, and to design and materials we must look for the next stages of development.

There are indications that there is an increasing realisation of the lack of theoretical justification for the existing methods of design of steel-framed buildings. The conventional design method has only three things to recommend it. It is quick, simple and within the capacity of engineers of very modest competence. In every other respect it transgresses all the rules imposed by the physical condition of the structure and assumptions to simplify the calculations are made without any foundation in fact. Thousands of roof trusses and lattice girders are designed every year as pin-jointed structures. Our fathers were honest about it and made their roof trusses with pin joints in conformity with the assumed design conditions. We, on the other hand, connect our truss members with joints of considerable rigidity, but we design them as if they possessed perfect freedom of rotation, just because it is easier that way.

Experience, both in Great Britain and abroad, shows that for steel-framed structures considerable economies can be achieved by adopting rigid joints and redundant frames; while for single-storey buildings the æsthetic effect of a portal frame far surpasses that of a roof truss on stanchions. The day is approaching when the conventional methods of design with their unjustifiable disregard of inescapable rigidity will be relegated to the past and full advantage will be taken of the beneficial effects of planned rigidity.

What is the obstacle to this desirable state of affairs? The reluctance to recognise indeterminacy in structures is not due to prejudice alone. It is mainly due to the fact that no really direct and rapid method of stress analysis has been evolved. Trial and error are essential features of design. Before the stresses in a redundant frame can be established, tentative sizes of the members must be assumed in order to ascertain their relative stiffness. Then follows an adjustment of the tentative sizes of the members to conform with the results of the first analysis, this procedure being repeated with successive approximations until the required degree of accuracy is attained. By the very nature of the problem, the stress analysis of a redundant frame will never approach the simplicity of that of the simple frame. There is a need for a method of rapidly predetermining the approximate relative stiffness of the constituent members and for less laborious methods of stress computation. The history of the theory of structures since the middle of the nineteenth century shows that increasingly attractive solutions have been presented and the obstacles to the more general adoption of indeterminate structures are being removed. Starting with Clapeyrons' Theorem of three moments in 1857, followed by Castigliano's Principle of Least Work, in 1879, and Mohr's Slope Deflection method in 1892, the moment distribution method of Professor Hardy Cross was introduced in 1930. The Hardy Cross method is a great advance and where it applies, it places in the hands of the structural engineer a rapid method of analysis, very easy to memorise and apply, and requiring nothing more abstruse than simple arithmetical calculation. It is not too much to hope that in the not too distant future, co-operation between the theoretical analyst and the practical designer will produce a reasonably simple method of stress analysis more in accordance with the actual behaviour of steel-framed structures than the conventional method in use to-day, with its unjustifiable assumptions.

Very valuable experimental work has been carried out recently under the ægis of the British Welding Research Association, at the Engineering Laboratory, Cambridge, and Professor Baker and his colleagues have initiated the development of a basis of design for rigid steel structures, taking into account stress redistribution effects due to plastic deformation.

Reinforced Concrete Structures

With reinforced concrete structures the method of design in general use is a working compromise between that for an ideal pin-jointed frame and for a monolithic structure. While this procedure cannot be called very exact, it has given satisfaction over a long period and unlike the conventional method of steel design, it does recognise and cater for the rigidity of the joints.

Reinforced concrete, like structural steel, has not escaped attention from the advocates of the plastic theory and a considerable amount of very valuable work in this direction has been done by Dr. Hajnal-Kónyi. When the load on a beam is increased until the maximum compressive stress approaches the ultimate strength of the concrete, further increase of the load does not produce an increase in the extreme fibre stress. The concrete reaches the plastic stage and the stress diagram changes from triangular to trapezoidal. The greater the load, the nearer the stress diagram approaches a rectangle. Extensive tests made by Dr. Hajnal-Kónyi and many other investigators on beams reinforced with high tensile steel confirm the calculations based on the plastic theory and illustrate some of the defects of the standard straight line theory. In accordance with this theory, which is in general use, the higher the steel stress the greater the depth of concrete required for the same resisting moment. This anomaly, for which there is no sound structural reason, is due to the inconsistency of the conventional method of design, which, assuming a triangular stress distribution, has the effect of raising the neutral axis with increased steel stresses.

The plastic theory is particularly applicable both for steel and reinforced concrete structures, when they are designed with an appropriate load factor to withstand load as a single entity instead of being designed to working stresses in their members with a factor of safety. Working stress has no functional significance in a structure; collapse load is the criterion. A factor of safety in a structural member based on the ultimate strength of the material is meaningless. A load factor related to the collapse load of the complete structure is the significant feature. This principle is followed in the design of aircraft—the newest form of structure—and there is no reason why it should not be followed in structural design.

The day of the pin-jointed structure, working stress, factor of safety, and elastic stress distribution is passing. The morrow will see the indeterminate structure, collapse load, load factor and plastic stress distribution.

Welding

In our modern economy steel is in fact a precious metal and steps will have to be taken in the future to reduce the quantity required to achieve any particular purpose. One of the most effective steps is the use of electric arc welding in steel structures. Many thousands of tons of steel could be saved annually, but there is a general reluctance to speed the changeover from riveting to welding in this country. Indeed, the trend since the end of the war has been towards abandonment of the great advances in steel fabrication, which welding has brought about, and reversion to riveting practice.

Let us look around for the reasons for the neglect of welding for structural steelwork in this country. In the first place there is too often a wide gap between the welding expert and the structural steel designer, which will have to be bridged if welding is to be the commonly accepted method of joining steel members. Similarly, a large number of structural engineers know little or nothing about the application of welding to design and construction. The technique of the design of welded steel structures is not the replacement of rivets by welds any more than the design of a motor-car is the replacement of the horse in a horse-drawn vehicle by an engine. The design of a welded structure involves the rejection of all preconceived notions as to the type of member and the construction of its joints, based on the practices of riveted construction. There is a lack of experienced designers accustomed to this procedure and of detailers capable of transforming their designs into working shop drawings. Until a new generation of structural steel designers has been trained in the design of welded structures—not merely the welding of details like cleats and stanchions bases—the welding of steel structures on a large scale cannot become normal practice.

Structural welding suffers from a further handicap in this country owing to the absence of sections suitable for economical welded fabrication. The joist, channel and angle sections rolled in Great Britain possess several disadvantages so far as welding is concerned. Sections more suitable for the welding processes will have to be produced if we are to take full advantage of welded fabrication for steel structures.

Another factor which makes for increased costs in welding work is the practice of distinguishing considerably more than is necessary between the work which a welder may perform and that which a plater may perform. The welder is rigidly excluded from any operation which may be considered the sphere of the plater and on far too many occasions the welder must needs have his hand-maiden, the plater, standing by with disastrous effects on the cost of fabrication.

Although riveting and bolting will always have a place in structural steel fabrication, it cannot be many years before welding will supersede riveting as the normal method of fabrication. At present, however, notwithstanding the appreciable saving in weight of steel, there is little, if any, saving in capital costs.

High Tensile Steel

High tensile steel is rapidly becoming a structural material of the greatest value and it has a decidedly greater corrosion resistance than mild steel. It has been employed in recent years on a large scale and its use has made possible the erection of large-span structures, which would have been impracticable in mild steel. High tensile steel achieves a greater strength than mild steel by the addition of comparatively low alloying contents, such as silicon, nickel and chromium, and it has a yield point some 50 per cent higher than that of mild steel.

Where mobile structures are involved, such as crane jibs, overhead travelling crane girders, and similar structures, the initial gain in steel economy is not the only advantage. Handling costs are reduced and operating economies follow by virtue of the reduced weight of metal to be moved in operation, thus giving a double advantage.

Aluminium

The lightness combined with strength of the aluminium alloys and the strict licensing control of steel have brought about a great expansion in the use of the former in recent years for roof trusses, purlins, ceiling members, &c. The use of aluminium alloys is particularly advantageous where the self-weight of the structure forms an appreciable proportion of the total loading, and in the case of mobile structures, cranes, excavators, &c. With comparatively minor changes in the usual practice of the structural steel shop, light alloy structures can be fabricated with equal facility, jointing being by means of rivets.

Although structural light alloys can be welded by the metallic arc process, using direct current with aluminium electrodes, the fact that heat-treated alloys are employed in structural engineering precludes the use of welding in stressed joints. The heat of the welding arc would reduce the metal to the softer state and destroy the strength obtained by the

*Institution of Structural Engineers. Swansea Branch. Abstract

initial heat treatment. The existing alloys have been designed to develop specific proof stresses and corrosion resistance qualities little attention so far having been given to weldability. Research is in progress, however, with a view to the development of weldable alloys and the future should see aluminium alloys with a 0·1 per cent proof stress not inferior to the yield point of mild steel and capable of being arc-welded as easily as mild steel can.

While the price of structural steel tends to rise, aluminium costs less to-day than it ever did before; in fact, it is the only industrial metal that is cheaper now than in 1939. There is no doubt that as production increases and the material comes into greater use, costs will decline still further. A great future exists for aluminium alloy as a structural material, when its cost is reduced, and the metal aluminium is available in largely increased quantities.

Notwithstanding their advantages, the utilisation of light alloys on a large scale in place of steel is not in the national interest at the present time. One ton of aluminium requires for its production 25,000kWh of electrical energy, equivalent to about 15 tons of coal. The same quantity of coal would produce 7½ tons of steel, which is equivalent to 2½ tons of aluminium, taking account of the difference in specific gravity.

Rebuilding a Reinforced Concrete Shed at Liverpool

A THREE-STOREY reinforced concrete shed being rebuilt at the Gladstone Dock, Liverpool, is 1500ft long, 150ft wide and 58ft 9in high. This shed, which is divided into five equal sections, each 300ft long, is used as a bonded warehouse, and during the war was partially destroyed in an air raid. The large stocks of rubber and other highly combustible materials in store were ignited and the ensuing fire lasted for three weeks. The intense and prolonged heat eventually caused the collapse of many structural members and the serious weakening of others, so that in three of the sections the roof had to be taken down, in two and a half sections destruction reached the second floor, and in one section all three floors had to be demolished. When demolition work was carried out it was found that the yellow and pink discolourations caused by various intensities of fire penetrated several inches into the heavy members and right through the smaller ones. As an indication of the immense heat, the surface of a brick wall was completely fused and had a glazed appearance where the molten silica had run down. Nevertheless, the reinforced concrete beam over it was still standing and not in bad condition.

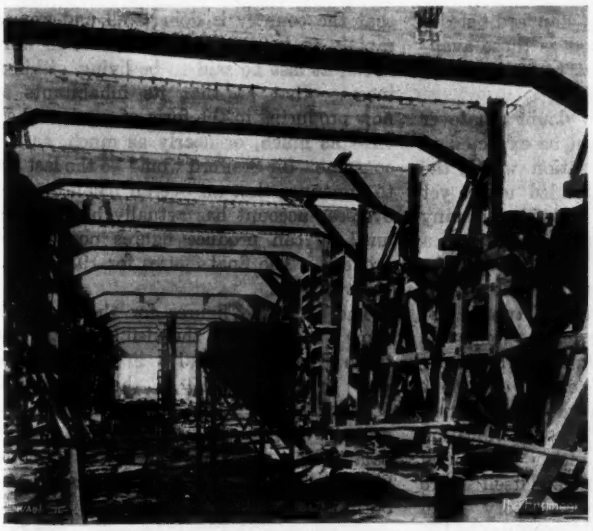
The original building was constructed by the engineer's department of the Mersey Docks and Harbour Board in collaboration with the British Reinforced Concrete Engineering Company, Ltd., and was completed in 1927.

It was constructed on a foundation of 15in octagonal reinforced concrete piles, 40ft long, in groups of twelve under each internal column and five under the side columns. Concrete floor and roof slabs were made 6in thick. The roof, designed for the storage of goods not affected by the weather, had a permissible loading of 20 cwt per square yard. Each of the 300ft long sections was divided into twelve bays, the main transverse beams being at 25ft centres. At adjacent ends of the 300ft sections main beams and columns were duplicated, so that in effect each section of the shed was independent. Cantilever balconies, originally 5ft wide at first-floor level, and 3ft 6in at the second floor, were provided to facilitate the loading and unloading of goods by crane or hoist.

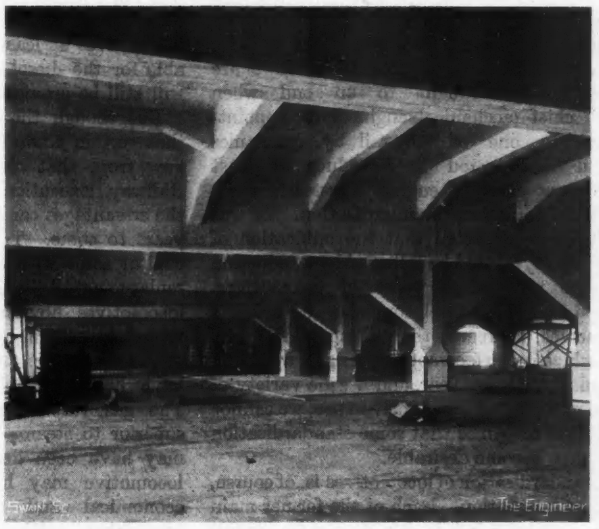
Rebuilding of the damaged portions of the shed, covering at roof level a length of as much as 900ft, was started in 1946. In the course of this work, some photographs of which we reproduce, certain alterations have been made in the original design. The width of the dock-side balconies has been increased—on the first floor to 8ft and on the second floor to 5ft. It has also been possible, in view of the increased allowable working stresses, to reduce the quantity of reinforcement used, while a further simplification has been the standardisation of the sizes of certain beams, which enabled repeated use to be made of the same formwork. Another innovation was the design of most of the secondary beams as precast units which were lifted into position between the formwork for the main beams, the main beams themselves being poured *in situ*. The designed loading of the first floor remains at 30 cwt per square yard, of the second floor 25 cwt per square yard, and of the roof 20 cwt per square yard, and as a condition of acceptance of the revised design a portion of the floor and balcony was tested with an overload of 50 per cent—a test which proved completely satisfactory.

The work of reconstruction has been carried out under the supervision of the engineer-in-chief, Mersey Docks and Harbour Board, by Peter Lind and Co., Ltd., while the British Reinforced Concrete Engineering Company, Ltd., has carried out the reinforced concrete design and has supplied the new reinforcement.

SHED IN COURSE OF CONSTRUCTION



PRE-CAST SECONDARY AND MAIN CAST IN SITU BEAMS



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NOTICE TO READERS

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LOCOMOTIVE STANDARDISATION

LOCOMOTIVE enthusiasts will have found little to please them in the recent announcement by the British Railway Executive that its plans are well advanced for the standardisation of locomotives and rolling stock throughout this country. The number of locomotive classes is expected to be restricted to a mere twelve, and it is hoped to have the first two standard locomotives in production in about two years' time. The days are thus finally brought to an end when each chief mechanical engineer on appointment to one of the railway companies could be expected to introduce at least one new class of engine. Instead, there is to be long-term standardisation. It was only to be expected that the unification of the railways would be followed by a reduction in the number of types of locomotives. Much though, as locomotive enthusiasts ourselves, we regret the passing of the days in which new locomotive designs appeared regularly year by year, and a wide variety of locomotives was constantly in use, we cannot help but recognise that some standardisation has now become desirable.

Standardisation of locomotives is, of course, not an innovation. Each of the former main line companies indulged in it to some extent. The Great Western Railway followed a single progressive scheme of standardisation for some forty years, and after the grouping of the railways in 1923, the London, Midland and Scottish Railway, in particular, very considerably reduced the number and classes of its engines. On the Indian Railways large numbers of standard locomotives have been in service for very many years. There is, then, no doubt, as a consequence of this experience, that the standardisation of locomotives brings in its train many practical advantages. Moreover, for its work in preparing a long-term scheme of locomotive standardisation the Railway Executive has now at its disposal not only the fund of knowledge and experience built up by the grouped companies, but it can also place before its designers facilities never before available in this country. With all the railways controlled by one body it is now possible to run types of locomotive found successful in one region upon lines far afield from their parent systems, and, as is now being done, to test them, comparatively, one against others, under widely differing geographical and climatic conditions. Practical running experience can thus be obtained to supplement the test data to be sought under "laboratory" conditions at the new Rugby testing plant. It is, we think, almost a foregone conclusion when such facilities are available that the Railway Executive should decide that standardisation upon a small number of types is both desirable and possible. For the benefits of standardisation in cheapening construction, facilitating maintenance and expediting turn-round and general operation are obvious enough. But there is another side to the account. Standardisation is a double-edged weapon. If it brings operational advantages it may also discourage bold advances in design. The supremacy of the steam locomotive is at the present time being seriously challenged by the diesel locomotive, and is likely to be challenged in the early future by the gas turbine locomotive. No doubt the Executive will continue to encourage the development of these forms of locomotive. But it would be very unfortunate if, in its desire to standardise the "steamer," corresponding developments in that locomotive called into being by the challenge of its newer competitors were to receive a check. All locomotive enthusiasts will hope that facilities for designing and experimenting with non-standard steam locomotives at least as good as those available for the diesel and gas turbine engines will still be provided.

But though there is no doubt whatever that certain advantages can be expected to flow from that standardisation which the Railway Executive has decided upon, yet the advantages cannot be fully felt for many years to come. The steam locomotive is a capital asset with a very long life and the replacement of the large numbers of excellent locomotives now in service of many and varied types will take at least twenty-five or thirty years. Who knows what may have happened in that length of time? The gas turbine may have proved itself superior to steam. Main line electrification may have been decided upon. The diesel locomotive may have proved itself more economical and more satisfactory than any other. We are driven to wonder, therefore, whether, in combination with a less ambitious scheme for the reduction of numbers of locomotive types, a scheme for the widespread standardisation of fittings and components might not prove of more immediate benefit than standardisation of locomotives as a whole. Each of the former main line companies had in operation some form of standardisation of fittings and components, and since the data and records are available it does not seem impossible that this standardisation could be extended to cover a high percentage of the existing stock of locomotives. A consequent reduction in the variety of spare parts required at locomotive depots would be helpful in maintenance, while costs of production of components might also be reduced by such a scheme. It is even possible that such standardisation of components could eventually lead to the overall standardisation of complete locomotives. But, no doubt, those possibilities have already been considered by the Executive and to some extent, at least, put into effect. Indeed, we feel that we must put the suggestion forward with unusual diffidence. For we are unhappily conscious that out of our love for and interest in the steam locomotive and our sorrow that it is to be produced in the future in a lesser variety than in the past, we may, like a drowning man, be clutching at a straw.

BRITAIN'S ECONOMY, MARSHALL AID AND AMERICAN IMPORTS.

WHEN Sir Stafford Cripps makes a speech which, for him, is almost optimistic, as he did at a Press Conference last week, it must surely be a portent! For we have grown to expect that Sir Stafford, whenever he speaks on economics, will present us with cold, hard facts and draw from those facts comfortless but undeniable conclusions affecting our standards of living, our salaries, our wages and our dividends. But we do not suggest that in the speech concerned Sir Stafford swung right across from one pole to the other. Far from it. The speech was, in fact, as bitterly realist as ever, and it was optimistic (by comparison with his earlier utterances) only because the facts and figures that he gave showed a promising improvement in this country's economic position. There was no suggestion that austerity can soon be relaxed; only the revelation through somewhat tentative figures that the country is doing well and appears rapidly to be approaching a state in which it can at last be said to be living within its income—that is, that its inhabitants are now producing in the form of goods and services as much, or nearly as much, as they consume. Sir Stafford would be the last man to announce that an overall balance on our overseas account has actually been reached until he can produce figures positively to prove it. The final figures for 1948 are not yet available.

The tentative figures for the year 1948 show a reduction in the visible unbalance of trade from £251,000,000 in the first half-year to £181,000,000 in the second half. If allowance is made for the very probable growth during the year of the positive balance on "invisibles" nearly to meet that latter deficit it is impossible not to feel some optimism about the future. But that optimism needs to be temperate. For there are plenty of signs that it will not be easy to

lift the rate of Britain's exports above or even to maintain them at the present level. We do not refer, thus cautiously, to any difficulty that may be experienced in increasing the output of industry within this country. For, even though the manpower in industry is unlikely to increase much further, we think that difficulty is exaggerated by the Government. If we may judge by the energy shown by those industries with which we are better acquainted, engineering, shipbuilding and iron and steel, there is plenty of ability being displayed to improve output and plenty of desire and determination to do so amongst industrialists and engineers only restrained by shortages of materials, ill-arranged taxation and Government controls. In the four-year programme submitted to the O.E.E.C. an annual increase of industrial productivity of 2½ per cent is envisaged. But for the three industries mentioned we regard that figure as very conservative. Even the figure of 5 per cent, the estimate Sir Stafford made in his speech for the actual increase of general industrial productivity during 1948 may well be exceeded in the industries concerned in the present year. For many new engineering shops and factories with up-to-date high productive equipment will be coming into use this year; the re-equipped iron and steel industry should soon be able to lift the output per head of labour employed substantially, and given more steel, the shipbuilders could certainly improve their output markedly without drawing very heavily upon the labour market. It is not, then, the ability of this country to produce more that we doubt; it is the ability of the country to export more that is questionable. For the export markets are beginning to display a much less pleasant aspect than they did. Competition is growing apace, and it is certain to continue to grow as the countries of Europe, recovering more slowly than Britain, successively regain their productive powers. Already there is plenty of complaint of German competition at prices which seem to British manufacturers to be unfair. Maybe our Government can and should take action upon that matter. But other nations, too, are beginning to quote prices with which it is hard for British firms to compete. How savage is this competition likely to become?

Since the countries of Europe and many outside Europe are all endeavouring, like ourselves, to increase their exports without simultaneously increasing imports to the same degree, the time may not be far distant when more goods are offered on the export market than there are buyers to pay for them. The successful nations will then be those that can offer the better goods at the lower prices. That is, of course, one of the reasons why Sir Stafford continues to press home the point that personal incomes in this country should not be allowed to rise unless productivity also rises. For only if rising incomes keep in step with rising productivity can prices, on the export as well as the home market, be kept down. But there is a further point to consider. The object of "Marshall" aid to Europe and of American loans to other countries is to permit those nations to buy essential goods unobtainable elsewhere during their periods of recovery. But "Marshall" aid does not prevent each country also attempting, as this country is attempting, to achieve an "overall" balance—that is, one in which the "Marshall" deficit with America is equalled by a corresponding surplus on accounts with other countries. But if, as recovery proceeds, all countries make that attempt, all, inclusive of America, will be trying to export more than they import, an impossible situation and the one which intensified, if it did not actually bring about, the great depression of the "'thirties." Nor can European nations, alone, avoid the dilemma. They must either continue to have deficits on their overall accounts, to be balanced by American loans, or, in attempting to free themselves of dependence on American aid, they must create savage and destructive competition in the export markets. The solution lies with the Americans. Between the wars American industrialists did not understand (even if it was ever suggested to them) that a country which refuses imports and yet attempts to boost exports can only do so at a loss to itself. It is true that, for a time, the Americans were paid for their excess exports in gold. But very certainly the American people would have been more benefited had foreign goods been more readily available on their home market than they were by piled-up hoards of gold in the vaults of banks. Moreover, if American exports and imports had been better balanced it may be doubted whether there would ever have been the great depression. Nor would there have been any substantial difficulty in the repayment of war debts. Fortunately, there are signs of better understanding across the Atlantic. In his annual report to Congress, President Truman recently remarked: "Balanced economic growth will require larger increases in our imports of raw materials and many other goods and services. . . . Our imports also provide exchange to purchasers of our exports." America will buttress her own prosperity as well as encourage Europe if, in the future and as Europe recovers, she progressively opens her home market to European goods.

Literature

Highway Bridge Design. By D. Y. Hill. London: Charles Griffin and Co., Ltd. 1948.

Just about nine years ago, we reviewed in these columns the author's previous work, "Bridge Calculations and Design" for steel bridges. The second book contains examples of reinforced concrete highway bridges and steel highway bridges, the former predominating. It can best be described as a casebook containing records of work carried out, the reasons for adopting a particular design, the methods of calculation used and the results obtained, rather than detailed instruction in making such calculations. The transition from reinforced concrete to steel is somewhat abrupt in some instances, and liable to be confusing in the case of extracts of working stresses from standards or codes, presented with little or no explanatory matter.

The preliminary chapters contain tables to facilitate the calculation of reinforced concrete beams. These are based on varying ratios of tensile stress in steel to compression stress in concrete, and record the corresponding position of the neutral axis, lever arm of the section and moment of resistance factor. In this form the tables can be adapted readily to the increased unit stresses recommended in the code recently issued by the Codes of Practice Committee.

There are brief chapters on culverts, steel bridges, posts and columns, and combined bending and compression. The longest chapters are concerned with arches and rigid frames. There are also lengthy earlier chapters on frame bridges, continuous frame bridges and continuous girders; the first of these three deals mainly with the calculations for portal frames, using formulæ developed from the theory of three moments, and the same theory is used for continuous girders. The chapter on continuous frame bridges is devoted mainly to moment distribution, as introduced by Professor Hardy Cross. Throughout the book considerable use is made of influence lines, which are briefly introduced in a short chapter. Abutments and wing walls of mass concrete and reinforced concrete, and bearings, rockers and expansion joints are dealt with in some detail. The final chapter on the architectural design of concrete bridges deals mainly with parapets and surface treatment.

The drawings are excellent and give a very good general indication of the structures described, together with the principal dimensions. There are also sixteen photogravures illustrating well-known and not so well-known highway bridges and some of the architectural details.

The student who has mastered the theoretical side of his training and is eager to put it into practice should find many interesting opportunities in this book. The bridge draughtsman will undoubtedly find it a useful book of reference.

Road Aggregates, Their Uses and Testing. By R. G. and B. H. Knight. Edward Arnold and Co., 41 and 43, Maddox Street, W.1. Price 25s.

The second edition of this book (Vol. III of the Road Makers Library) has recently appeared under the joint authorship of Professor B. H. Knight and Rena G. Knight. This edition has maintained the high standard of its predecessor, and will serve even as a better standard of reference than the first edition. It sets out clearly the latest information that is available on all aspects of road stones. The book has been largely rewritten, the section on petrology being the only part of the book that has not been changed. The first chapters describe the petrological properties of rocks and give a clear exposition that can be followed without previous specialised geological knowledge; the system of classification according to silica content and crystal size is particularly useful to the highway engineer, and the matter set forth should at least help him to meet the author's wish to describe the various road stones by their true geological names.

As the primary object of the authors is to describe the quality of aggregates in relation to their use as road stones, considerable space has been devoted to a discussion of the relation between their petrological and their mechanical and physical characteristics. As a result, the authors, after outlining in some detail the various mechanical tests, devote a chapter to a

critical survey of both standardised and unstandardised tests for road stones by mechanical, physical and chemical methods. Although there appears to be reasonably good correlation between a number of the mechanical tests irrespective of the type of stone, it is doubtful whether, apart from broad generalities, correlation has yet been established with road performance. Before this desirable objective can be attained it is apparent that a more exact knowledge is required of the performance of different road aggregates in road surfacings. The performance of various types of rock-stone setts seems to be reasonably assessed and the quantitative information is now required on the performance of stones in different types of surfacing. The successful use of aggregates in bituminous road construction is dependent on adhesion to the binder being permanent and unaffected by water. The authors conclude that the surface texture of the stone is the property that largely determines its adhesion characteristics, and its mineral composition is of importance in this respect only in so far as it affects surface texture. The authors point out that although it is a relatively simple matter to test a road aggregate it is by no means so simple to evaluate accurately its road-making qualities; at present experience is largely the basis of assessment.

The last few chapters of the book deal with the gradings and sieve analyses of aggregates for bituminous mixtures and concrete for road construction, and give some practical hints on the standard methods of making specimens for petrological examination.

Principles of Jet Propulsion and Gas Turbines. By M. J. Zucrow. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. 39s.

In an apparent attempt to exploit topical interest in the subject, more than one book has been published which, though ostensibly about gas turbines, appears, on closer examination, to be merely a "re-hash" of a steam turbine treatise, spiced meagrely with a little information about the newer gas turbine. Professor Zucrow's book, however, represents an attempt to produce a genuine gas turbine, jet propulsion textbook, the author drawing on his experience as a teacher of these subjects on a wartime course, sponsored by the United States Government, to present a blend of basic theory and practical information designed to lead to an understanding of the modern aircraft prime mover.

The four chapters on fundamental principles and thermodynamics with which the book opens are well presented and provide an introduction to non-dimensional quantities and to the modern concept of the thermodynamics of a gas in motion, as well as dealing with the more commonplace topics of momentum energy and the physical properties of air. Then follow, somewhat illogically, two chapters on aeroplane and propeller characteristics, which, though necessary in a book concerned only with the aeronautical application of the gas turbine, interrupt the development of the main theme of the book and could profitably have been postponed.

The gas turbine power plant is, in consequence, not introduced until nearly halfway through the book, and its treatment is in a few places a little disappointing after the promise of the earlier chapters. The author cannot be expected to deal in much detail with the intricacies of component design, but one would have expected the section on centrifugal compressors, say, to contain more about the design and performance of the diffuser, even if it necessitated a shortening of the discussion on the impeller. Some reference to the non-dimensional presentation of overall engine performance might also have been expected after the careful introduction of non-dimensional quantities in the first chapter. However, there is a good deal of generally useful information in these chapters, and the book concludes with articles on the rocket motor and high-temperature metallurgy, both of which are of interest.

The author includes numerous examples, a fairly comprehensive bibliography to each chapter, and some useful tables for the physical properties of air. Rather unfortunately for the reader in this country, where the use of the Centigrade temperature scale has become customary in dealing with aircraft gas turbines, the author naturally follows American practice and uses Fahrenheit units. In spite of these minor criticisms, however, the reader new to the subject will find that the book in very large measure achieves its aim of presenting the fundamental theory requisite for an understanding of jet propulsion and gas turbine power plants.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

THESES

Sir,—If the Institutions concerned could once and for all dispel the ignorant—and sometimes damaging—taunt that admission to corporate membership by thesis is less meritorious than by examination, they would be rendering a service to critics, candidates and themselves alike.

While it is true that a candidate has a choice of subject, the knowledge required in that particular subject is far deeper and must also display originality of scientific thought and technical general knowledge.

The fact that barely 40 per cent of theses succeed surely speaks for itself.

To my knowledge, many candidates after failing in repeated attempts to find even a subject for a thesis have sat for and sailed through the examination with comparative ease!

Discriminated
Middlesex, January 6th. (A.M.I.Mech.E.)

PERSONNEL MANAGEMENT AND WORKS MANAGERS

Sir,—I do not wish to open a barren controversy on the relative importance of the different functional grades in industry, but I would like to correct the impression which will probably be left in readers' minds by a sentence in Mr. A. K. Rice's interesting article on "Personnel Management and Works Managers," in your issue of December 31, 1948.

Mr. Rice's statement "... the modern works manager must work in co-operation with and *in accordance with the decisions of* sales manager, buyer, production engineer ..." leaves the impression that the works manager is at the beck and call of every functional specialist, whereas, in actual fact, he is still the executive responsible for all aspects of production and must therefore be recognised as occupying a vital position in British industry at the present time.

A. P. Young
Institution of Works Managers,
London, W.C.2.
January 6th.

Research and Development in Agricultural Engineering

The Ministry of Agriculture has this week announced a decision to make a change in the administration of research in agricultural engineering. For the past seven years the Agricultural Machinery Development Board has been responsible for advising on research and development work on agricultural mechanisation, and on the management of the National Institute of Agricultural Engineering. Prior to that, such research had been entrusted to the University of Oxford, which received grant aid for the purpose from the Ministry of Agriculture. The Agricultural Machinery Development Board is now being replaced by a new and independent governing body, the National Institute of Agricultural Engineering, which is to be constituted legally as a company limited by guarantee and without share capital, and will receive grant aid from the Ministry of Agriculture and the Department of Agriculture for Scotland. The headquarters station at Wrest Park, Silsoe, Bedfordshire, and the Scottish station at Howden, are thus to be continued under this new arrangement. The members of the governing body have been appointed jointly by the Minister of Agriculture and the Department of Agriculture for Scotland, with the advice of the Agricultural Research Council. The Earl of Radnor is the chairman of the governing body, the other members being Mr. S. Brumby, Mr. H. H. Dawson, Professor W. Ellison, Dr. G. A. Hankins, Mr. G. C. Hole, Mr. J. Mackie, Mr. F. Rayns, Dr. E. W. Russell, Professor A. W. Scott, Mr. A. B. Turnbull, and Mr. D. S. Tyzack. The research programmes of the National Institute will come under the general scientific supervision of the Agricultural Research Council, which is to appoint a standing committee on agricultural engineering research to assist the Council in the planning of such research, whether at the National Institute of Agricultural Engineering or elsewhere. The Agricultural Machinery Development Board has also recommended the setting up of an Agricultural Machinery Advisory Committee to advise on the requirements and supply of agricultural machinery. This committee has been constituted under the chairmanship of Mr. G. S. Dunnett, Permanent Secretary of the Ministry of Agriculture, and consists of representatives of the Ministries interested, the National Farmers' Union, the Agricultural Engineers' Association, agricultural machinery dealers, and the Trades Union Congress. The committee is a permanent body, its terms of reference being "to keep under review the requirements and supply of agricultural machinery, including the development and production of new machines, and to consider and report upon matters referred to it by Ministers."

BOOKS RECEIVED

Slogans. London: Day's Publication and Services, Ltd., 93/4, Chancery Lane, W.C.2. Price 30s.

Photoelasticity. Vol. II. By Max Mark Frocht, London: Chapman and Hall, Ltd., 37, Essex Street, W.C.2. Price 60s.

Non-Ferrous Castings. By R. F. Hudson. London: Chapman and Hall, Ltd., 37, Essex Street, W.C.2. Price 22s.

Photographing Machinery. By Bernard Alfieri. London: The Focal Press, 31, Fitzroy Square, W.1. Price 7s. 6d.

Mechanics. By J. P. Den Hartog. London: McGraw-Hill Publishing Company, Ltd., Aldwych House, W.C.2. Price 27s.

Machine Design. By Paul H. Black. London: McGraw-Hill Publishing Company, Ltd., Aldwych House, W.C.2. Price 24s.

Industrial Weighing. By Douglas M. Considine. London: Chapman and Hall, Ltd., 37, Essex Street, W.C.2. Price 60s.

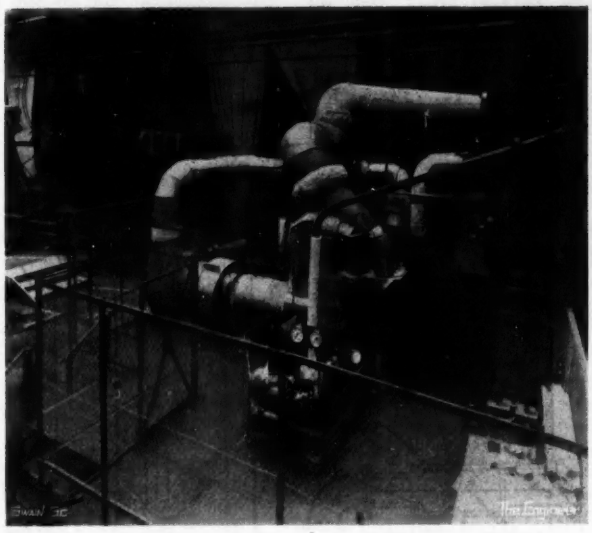
The Railway Handbook, 1948–49. London: The Railway Publishing Company, Ltd., 33, Tothill Street, S.W.1. Price 5s.

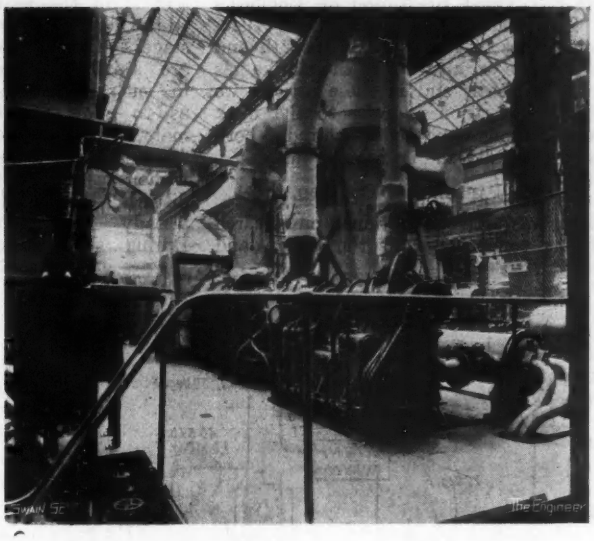
Engineering Metallurgy. By W. E. Woodward. London: Constable and Co., Ltd., 10, Orange Street, W.C.2. Price 15s.

Gas Turbines in 1948

No. I

IN the period under review, no commercial gas turbines were put to work in Great Britain, but new test units were completed and work proceeded on large industrial gas turbines, which within the next two years will be commissioned for service in power stations and in works. The year 1948 was also remarkable for the entry of new firms into the gas turbine field. On the Continent and in America progress was reported and units were put to work and in 1948 saw actual service. In these articles it is our intention to review briefly the progress made.





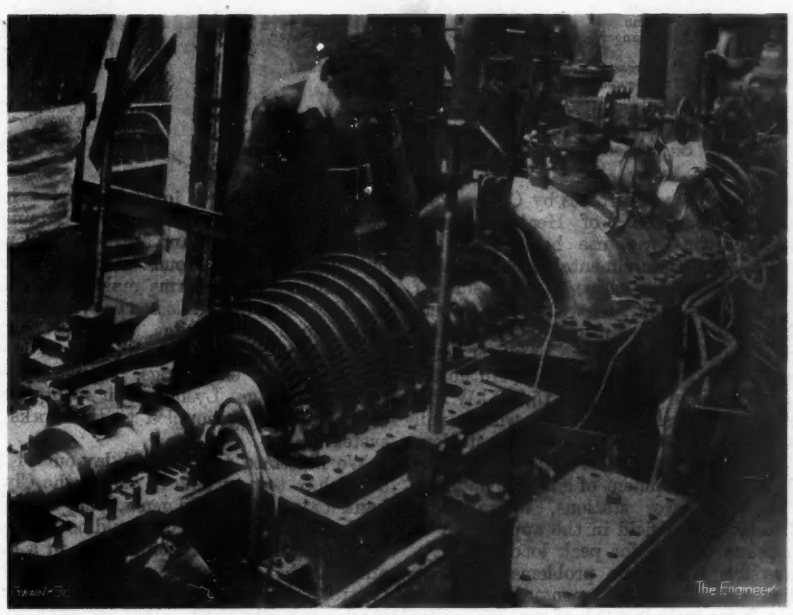
JOHN BROWN 500-B.H.P. OPEN-CYCLE TEST GAS TURBINE

Some Gas Turbine Papers

During the past year several papers were read before British scientific and technical institutions on various aspects of gas turbine development. Early in January, 1948, Mr. T. A. Crowe, M.Sc., M.I.Mech.E., the engineering director of John Brown and Co., Ltd., Clydebank, gave the twentieth Thomas Lowe Gray Lecture before the Institution of Mechanical Engineers, choosing as his subject "The Gas Turbine as Applied to Marine Propulsion." An abstract of that paper was reprinted in our issues of January 30, February 6 and February 13, 1948. After making an historical survey, Mr. Crowe dealt with different turbine cycles and the problems connected with starting, power control and reversing. He stressed the need for reliability, long life, low upkeep costs, economy, savings in space occupied, and weight, as essential factors for success in marine service.

On February 2nd an important paper was presented to the North-East Coast Branch of the Institution of Mechanical Engineers, jointly by Dr. A. T. Bowden, B.Sc.(Eng.), Ph.D.(Edin.), M.I.Mech.E.; Mr. J. L. Jefferson, B.A.(Cantab), M.I.Mech.E., and Mr. W. P. Davey, B.Sc.(Eng.), on "Some Aspects of Industrial Gas Turbine Developments." Fundamental considerations were dealt with by Dr. Bowden, who gave comparative figures for steam and gas turbine installations of about 15,000kW output. The experiments, which led up to the design and building of the Parsons 500 b.h.p. test turbine, were described by Mr. Jefferson, after which Dr. Bowden discussed the various tests on oil fuels and the combustion experiments carried out on the set.

Considerations affecting the thermodynamic design of gas turbine plants were dealt with by Mr. Davey, who stressed the advantages of utilising the waste heat available in gas turbine installations, showing that a considerable amount of the heat added in the reheat chamber can be recovered by a waste heat exchanger.



JOHN BROWN TURBINE WITH UPPER CASING REMOVED

In June, 1948, at the Incorporated Municipal Electrical Association Convention at Eastbourne, Mr. H. G. Bell, M.I.E.E., and Mr. D. M. Smith, read a paper on "Gas Turbines for Public Electricity Supply." That paper was reprinted in our issue of June 11th and it dealt fully with operating conditions and problems and the advantages of gas turbine-driven generating plant for public supply. During the year attention was given to the utilisation of gas turbines for road transport vehicles, and units were developed by the Rover Company, Ltd., and Centrax Power Units, Ltd. A paper by Mr. R. H. H. Barr, B.Sc., of the latter company, on this subject was reprinted in our issue of July 2nd.

In November, the Institution of Mechanical Engineers arranged a series of lectures on internal combustion turbines, given by the staff of the National Gas Turbine Establishment of Farnborough. The first, on "The Prospects of Land and Marine Gas Turbines," was delivered by Mr. Hayne Constant, M.A., M.I.Mech.E., F.R.S., and an abstract of it was printed in our issue of November 12th. Other lectures in the same series included "The Part-Load Performance of Various Gas Turbine Schemes," by Mallinson and Lewes; "The Fuel Problem of the Gas Turbine,"

by Mr. P. Lloyd; "The Performance of Axial-Flow Turbines," by Mr. D. G. Ainley; "Heat-Flow in the Gas Turbine," by Mr. A. G. Smith, and "Three-Dimensional Theories for Axial Compressors and Turbines," by Mr. A. D. S. Carter. These lectures will be published in a special issue of the "Emergency Proceedings."

One of the fullest accounts of British gas turbine work and progress was given by Dr. T. W. F. Brown, D.Sc., S.M., the research director of Pametrada, in the Thirteenth Parsons Memorial Lecture, delivered to the North-East Coast Institution of Engineers and Shipbuilders on December 10, 1948. In our issues of December 17th, 24th and 31st we gave an abstract of the marine gas turbine proposals and in these articles we shall have occasion to refer to the work which is being done by Pametrada, both for the Admiralty and its member firms.

C. A. Parsons and Co., Ltd.

Work was actively continued on research problems connected with the design and construction of gas turbines by C. A. Parsons and Co., Ltd., of Heaton Works, Newcastle-upon-Tyne, use being made of the 500 b.h.p. experimental turbine plant already described in these pages. Some of that work was fully reviewed in the papers read before the Institution of Mechanical Engineers referred to in the previous paragraph. The British Electricity Authority has ordered from the firm a 15,000-kW gas turbine-driven generator set, which will be set to work in the Dunston power station. The object of this pioneer installation is to further the development of gas turbine plant for electric power stations, where there is already a good field in the application of such prime movers for peak load capacity. It was felt that these problems could be studied and the requirements better met with a large unit instead of smaller units, and for that reason a 15,000-kW unit was decided upon.

Another order which the company has on hand is the construction of a 10,000-kW unit for the National Gas Turbine Establishment. The design of both these units will embody the open cycle, using an initial gas temperature of about 1200 deg. Fah. In the case of the 10,000-kW set it is proposed to include plant which will allow for the utilisation of otherwise waste heat from the gas turbine installation. Waste heat recovery has often been spoken about in technical papers and discussions, but we believe that this will be the first occasion upon which such plant has been included as an integral part of a scheme.

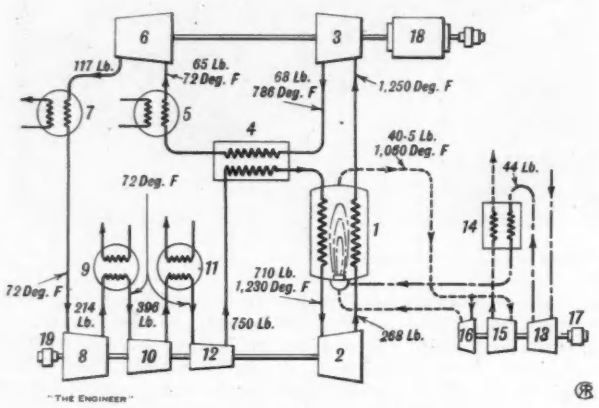
John Brown and Co., Ltd.

In June last year, John Brown and Co., Ltd., completed at Clydebank the first gas turbine of the industrial type to be built in Scotland. It was designed by Pametrada and is of the multi-stage, impulse type. In the first and second stages the blades are axially inserted in such a manner as to allow various materials and blade forms to be tested, without having to disturb the blades already in place. During the last six months careful investigations have been carried out on the effects of running at certain temperatures and stresses. Throughout these tests close touch with the research departments of the firms making the heat-resisting blade materials has been maintained and valuable knowledge has been gained. The turbine unit, which we illustrate in the accompanying engravings, supplies power to a two-stage Lysholm air compressor, which is directly coupled to the works air system.

We illustrate the general lay-out of the 500 b.h.p. test turbine in one of the Clydebank fitting shops. In general, the assembly conforms with that which would be employed when installing gas turbine plant in a ship, and all the auxiliaries, pipework and the control arrangements are made according to marine specifications. We are enabled to publish two views of this test turbine, taken one from the starting turbine end and the other from the Lysholm compressor end. In the first engraving the small steam turbine, which is employed to run up the set to operating speed, will be seen in the immediate foreground of the picture. The main turbine is behind the starting turbine and to the left at right-angles to the turbine is the combustion chamber. On the extreme right will be seen the filters on the air intake to the compressor; the connecting mains from the filters to the compressor air intake pass below the floor. The air delivered from the compressor goes at high pressure to the heat exchanger, in which it takes up heat from the exhaust gases of the main turbine. The control panel and the main gauge board are on the right-hand side, behind the air intake and filters. The instrumentation of the test unit is very complete so that when in operation the full thermodynamic performance of the turbine and the compressor can be studied. We also reproduce a view of the turbine with its upper cover removed, showing the seven blading stages. In the first and the second stages different materials are employed in order to test the heat and stress-resisting properties. In the tests made close touch has been maintained with the manufacturers of the specialised heat-resisting materials, and the information gained as to corrosion and fatigue will without doubt contribute to the design of long-life gas turbine machinery.

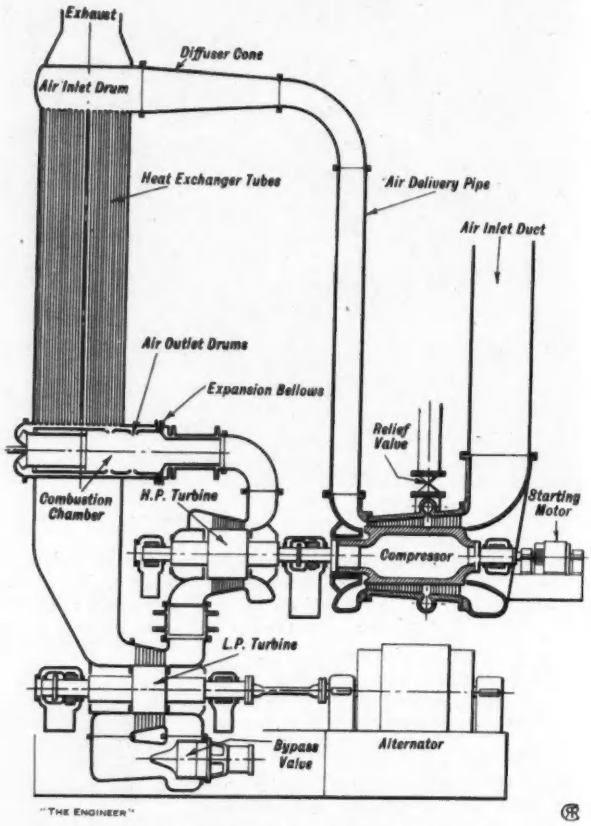
Work is also well advanced at Clydebank on the design and construction of the 12,500-kW, closed-air cycle, turbine-driven generator, which is being built under licence from the Escher Wyss Engineering Works, Zürich, and operates on the Ackaret-Keller principle. In many respects that unit is generally similar to the set now under completion in the Zürich workshops for the Gennevilliers power station near Paris.

The Scottish turbine is to be installed in the Carolina Port power station, Dundee, for the North of Scotland Hydro-Electric Board. It will be put to work at the end of 1950 and will use heavy oil fuel of about 18,500 B.Th.U.s per lb gross calorific value. A figure of about 32 per cent efficiency, based upon the output of the plant



1 Air Heater
2 H.P. Turbine
3 L.P. Turbine
4 Heat Exchanger
5 Pre-cooler
6 L.P. Compressor
7 First Inter-cooler
8 First I.P. Compressor
9 Second Inter-cooler
10 Second I.P. Compressor
11 Third Inter-cooler
12 H.P. Compressor
13 Combustion Air Compressor
14 Combustion Air Pre-heater
15 Exhaust Gas Turbine
16 Re-circulating Gas Fan
17 Motor Generator
18 Main Generator
19 Starting Motor

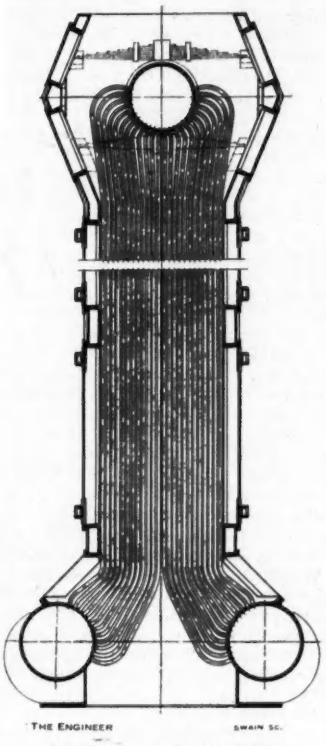
Layout of 12,500-kW Plant for Dundee—John Brown



1200 S.H.P. Marine Plant—B.T.H.

at the terminals of the generator, will place this set among the highest in efficiency installed in this country.

From the cycle arrangement illustrated in the accompanying drawing, it will be seen that there are two turbines in series, with four stages of compression. The high-pressure air from the air-heater 1 enters the high-pressure turbine 2, in which it is expanded to give sufficient power to drive both the high-pressure and the intermediate-pressure compressors. It will be seen that



B.T.H HEAT EXCHANGER

the high-pressure turbine 2 and the compressors form a self-running group, which will rotate at a constant speed independent of the output from the low-pressure turbine. That turbine 3 drives the alternator 18 and the low-pressure compressor 6. On leaving the high-pressure turbine, the air moving in closed circuit again enters the air heater, in which it is reheated to a temperature of 1250 deg. Fah. before entering the low-pressure turbine, in which it is expanded down to the lowest pressure in the circuit. The majority of the heat from the exhaust of the low pressure is given up to the relatively cold air coming from the high-pressure compressor in the heat exchanger 4. The waste heat is taken out of the closed circuit air by the pre-cooler 5, and it then passes into the low-pressure compressor 6. It will be seen from the diagram that there is an intercooler between each of the four compressors 6, 8, 10, and 12, in which the air is cooled down to within a few degrees of the cooling water available, thereby increasing the cycle efficiency and reducing the power needed to drive the compressors.

Combustion takes place within the air heater at an absolute pressure of about 40 lb per square inch. A radial blower 13 raises the combustion air to that pressure and before reaching the air heater it passes through the combustion air pre-heater 14. Part of the exhaust gases leaving the heater pass through a turbine 15, which is employed to drive the compressor 13 and the recirculating fan 16. That fan takes the remainder of the exhaust gases and reintroduces them into the combustion chamber, thereby helping to lower the flame temperature and to keep the heater tubes at a reasonable working temperature. A feature of the closed air cycle plant is the small size of the individual turbines and compressors, which make a compact plant for the power generated. In the Dundee power station the gas turbine plant will develop more than twice the power of the steam plant it will replace, and it will be possible to accommodate it in the same building. The only alteration needed will be a slight increase in the height of the boiler-house roof in order to accommodate the air heater.

The British Thomson-Houston Company, Ltd.

During 1948 the British Thomson-Houston Company, Ltd., of Rugby, made good progress with the construction of the 1200 s.h.p. marine gas turbine, which it is building for installation in the Anglo-Saxon Petroleum Company's oil tanker "Auris," a view of which is reproduced elsewhere in this issue. The gas turbine, we may recall, will replace one of the four diesel engines now driving the 880-kVA alternators. The combustion tests are proceeding satisfactorily and it is expected that the trials of this unit will begin during the summer months of this year.

The drawing we reproduce shows the three units, the low-pressure turbine alternator, the compressor high-pressure turbine, and the heat exchanger combustion chamber, in their substantially correct relative positions. This particular design was influenced by the need to accommodate the gas turbine in the space occupied by the diesel engine, and its main object will be to obtain actual running service under sea-going conditions, which will form the basis for designing a larger and a more economical unit.

It will be seen that a single axial-flow compressor has been adopted. The atmospheric air passes through the inlet duct to the compressor. From the compressor it passes by the air delivery pipe through a cone-shaped diffuser to the air inlet drum of the heat exchanger. It then passes down the tubes of the heat exchanger, shown in detail in the accompanying drawing, to the twin air outlet drums, one on either side of the turbine exhaust, in which the combustion chambers are incorporated. The heated gases flow through short bends to the high-pressure turbine which drives the air compressor, and from that turbine to the low pressure turbine, to which the alternator is directly coupled. On leaving the low-pressure turbine the gases pass upwards through the heat exchanger, contra-flow to the descending compressed air in the tubes. From the heat exchanger the cooled gases flow upwards to the funnel.

The unit is started by an electric motor attached to the compressor shaft. In order to prevent surging at high speeds and to facilitate easy starting, the air compressor, it may be noted, is fitted with a relief valve at an intermediate stage. Below the low-pressure turbine there is a by-pass for the purpose of passing the gases from the high-pressure turbine exhaust direct to the atmosphere through the heat exchanger. Such an arrangement prevents the over-speeding of the low-pressure turbine-alternator shaft should the electrical load suddenly fall. Attention may be drawn to the arrangements made to allow the component parts to expand freely by means of bellows, so that they are relieved from forces arising from heat expansion and gas pressure. The design of the heat exchanger is noteworthy, as the flow area for the exhaust gases amounts to about 70 per cent of the total inside cross-section of the heat exchanger casing. The springing of the top drum and the provision of large doors for cleaning may be noted.

The unit is designed for an ambient air temperature of 68 deg. Fah. at atmospheric pressure. The pressure ratio of the compressor is 4·2 and the maximum turbine inlet temperature 1200 deg. Fah. With 18,000 B.Th.U. fuel, the set will have an overall efficiency of about 20 per cent and a fuel rate at the design point of 0·70 lb per s.h.p. hour. The efficiency of the heat exchanger is 50 to 55 per cent. The high-pressure turbine and compressor runs at a speed of 5750 r.p.m. and the low-pressure turbine and alternator at 3000 r.p.m. The test results of this first British-built marine gas turbine will be awaited with interest.

(To be continued)

Metropolitan Water Board

WORKS IN PROGRESS AND CONSTRUCTED DURING 1948

Ashford Common.—This work comprises the construction of a new filtration works and pumping station on land east of Queen Mary reservoir, together with the laying of two mains to convey the filtered water into supply. The output of the station when completed will be 90 million gallons per day, and the water treatment plant includes aeration basins, a battery of micro-screens, thirty-two slow sand beds, each about ¾ acre in area, and contact and balancing tanks.

Soil stripping and excavation over the site of works has been completed except for a small area, and about 81 per cent of the soil stabilisation has been finished. A camp has been erected to accommodate 600 men and considerable progress has been made in the construction of the first sixteen slow sand filter beds. The contractors for the civil engineering work are John Mowlem and Co., Ltd.

The pumping machinery will consist of electrically-driven low-lift and high-lift pumps, and the tenders for this plant will be due shortly. A complete source of power for standby and peak load relieving will be provided by four diesel alternators and two gas turbine alternators.

All-welded steel pumping mains 54in and 48in diameter, from Ashford Common to Kempton Park and Hampton Hill are being laid by J. L. Eve Construction, Ltd. Since July, 1948, 1104 yards of 54in main and 1303 yards of 48in main have been laid. A third large diameter main will be laid at a later date to supply areas south of the Thames.

Barnes.—A concrete contact and balancing tank is being constructed at Barnes works. The tank will be in two separate compartments, one to deal with water produced at Barn Elms and the other to deal with water produced at Barnes. Each compartment will provide two hours' contact at the maximum rate of filtration and, in addition, the Barnes portion will provide about 1,000,000 gallons balancing capacity to enable the filters to be operated at a constant rate.

A 12in concrete sub-floor has been placed over the whole site of the contact tank and concreting to wall footings and walls is in progress. About 29 per cent of the concrete columns have now been precast.

The scheme also provides for electrically-driven low-lift pumps, mains and chemical treatment apparatus at Barnes works, and the provision of electrically-driven low-lift pumps at Barn Elms.

Bexley.—The supply at this station is being developed by sinking a well, approximately 6ft in diameter, to a depth of about 120ft, and by driving headings from this well to connect to the existing bore-holes. The well has been sunk to a depth of 100ft and 92ft of the permanent cast iron segments have been grouted in position. A contact tank for the chemical treatment of the water at this station has also been constructed.

FILTER BED POROUS CONCRETE FLOOR AT HAMPTON

Chingford.—The new storage reservoir, when completed, will have a capacity of 3400 million gallons, and is the last of the storage reservoirs which can be built in the Lee Valley. Work has continued during the past year on the raising of the embankment, together with the core wall. Concreting the lining of the inner slopes of the reservoir has also progressed.

Hampton.—Under the remodelling scheme begun shortly before the war, the capacity of these works has been increased from about 55 million gallons per day to 120 million gallons per day. All work required to be carried out by William Moss and Sons, Ltd., under the contract for the construction of primary filters has been completed. Construction of an 11·3 million gallon balancing reservoir by the same contractors is also almost completed, and screening apparatus has been supplied and erected by Guest and Chrimes, Ltd.

In August, 1948, the contract of William Moss and Sons, Ltd., for the construction of a 54in raw water conduit of welded steel shells for increasing the supply of raw water from Queen Mary and the Staines reservoirs was completed.

The reconstruction of the low-level slow sand filter beds by direct administration is in progress. Accompanying illustrations show filter beds under construction and the arrangement of under drains.

Kempton Park.—In our issue of January 16, 1948, reference was made to the two new steam-raising plants, totalling 30,000 lb per hour normal capacity ordered from John Thompson Water Tube Boilers, Ltd. Foundation work has been completed, the boiler parts are being delivered, and erection is about to begin.

The Candy Filter Company, Ltd., and the Paterson Engineering Company, Ltd., are installing two experimental purification plants, each of a nominal capacity of 1,000,000 gallons per day, on a site adjoining the main works. The assembling and installation of plant by the Candy Filter Company, Ltd., is approximately 75 per cent complete and building work for the Paterson Engineering Company is nearing completion.

Lee Bridge.—The interim scheme for the reconstruction of these works is now well advanced. Eight d.c. electric low-lift pumps have been delivered by Hathorn Davey and Co., Ltd., and erection is proceeding. A pressed steel plate reservoir having a capacity of 3,000,000 gallons—see accompanying illustration—has been erected by Braithwaite and Co., Engineers, Ltd., and brick baffle walls are being constructed by direct administration. Mainlaying work by Messrs. William Press and Son is almost completed.

Trunk Main—Kempton Park to Cricklewood.—This 60in diameter steel main with Johnson couplings, approximately 13¼ miles in length, is being laid for conveying additional water required in North-West and North London. A contract for laying the Kempton Park to Wesley Avenue section has been placed with J. B. Edwards and Co. (Whyteleafe), Ltd., and the order to commence work was given on October 11, 1948. A tunnel, which will be 283 lineal yards long when completed, is being driven under Feltham sidings.

Walton.—To improve the efficiency of the works by decreasing the rate of filtration by providing an adequate reserve of filtering surface, four new secondary filter beds having a total area of 3·28 acres are being constructed by John Mowlem and Co., Ltd. The walls, floors, and channels of the filters have been completed.

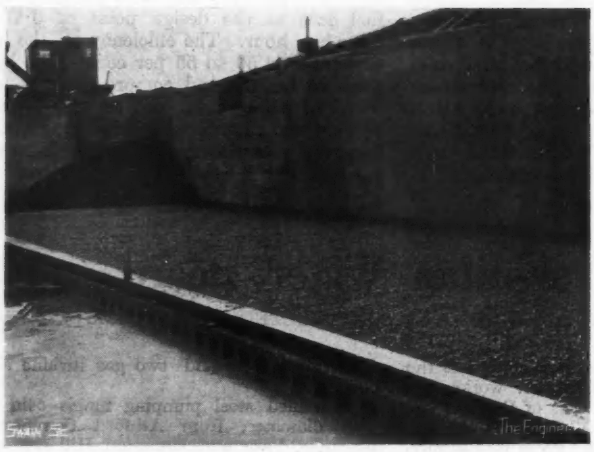
General.—As stated in our issue of January 16, 1948, the main objects which the Board has in view are, first, the provision of additional filtration works adequate to cope with the greatly increased and rapidly increasing demand for water, and, secondly, the construction of further storage reservoirs not only to provide for an increased filtration capacity but also to rectify a shortage of storage which already exists.

For the augmentation of supply to the Kent area, three bore-holes are under construction. At Brasted a 36in diameter bore-hole is being put down to obtain water from the Hyde beds of the lower greensand, and at Horton Kirby and Shoreham 24in diameter bore-holes are being sunk into the chalk formation.

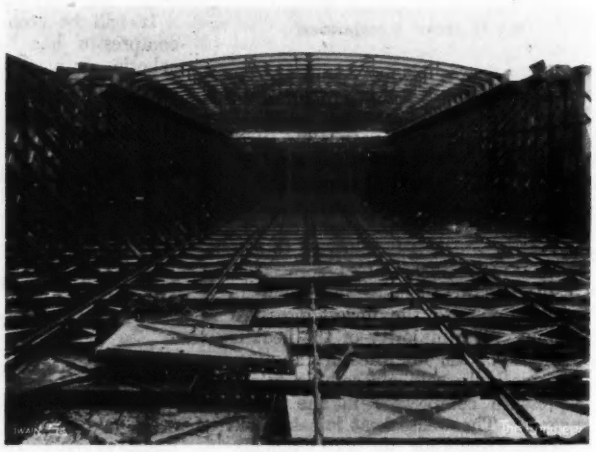
There is also the necessity to replace on a considerable scale obsolete steam-driven plant at many places. Examples of this kind are the installation of electrically-driven pumps at Cricklewood, Hammersmith, Stoke Newington and Wilmington. Additional electric pumps are also being installed at Fortis Green and at Littleton pumping station an existing steam-driven pump is being converted to electric drive to relieve the load on the boiler plant.

Many miles of mains up to 24in diameter are being laid for the improvement of supplies in the Board's area.

A number of other large schemes, including the laying of a main about 60in diameter, partly in tunnel and partly in trench, from the eastern end of Hampton works to the south end of King George's reservoir, Chingford, have been approved by the Board, and have been submitted to the Ministry of Health for authorisation. The proposals for the last-named scheme were fully outlined in our issue of December 17, 1948.



POROUS CONCRETE UNDERDRAINS AT HAMPTON



STEEL PLATE RESERVOIR AT LEE BRIDGE

MECHANICAL PROPERTIES OF RUBBER.—Two public lectures on "The Mechanical Properties of Rubber" are to be given by Mr. A. H. Willis, Wh.Sc., A.M.I.Mech.E., at King's College, London, W.C.2, on Tuesdays, February 1st and 8th, at 5.30 p.m.

South Bank Thames River Wall

ON Monday last work was begun upon the building of the new south bank Thames river wall in London. About four o'clock Mr. Herbert Morrison, the Lord President of the Council, turning an air-valve, started a pile-driver, which drove the first steel sheet pile for No. I cofferdam. That pile will remain in the river bed as part of the new wall.

At a meeting which was held in the Conference Hall of the County Hall at 3 p.m., Mr. Morrison was welcomed by Mr. Walter R. Owen, J.P., the Chairman of the London County Council, and he spoke of the development of the south side of the river, mentioning the County Hall, the rebuilding of Waterloo Station, and more lately the new Waterloo Bridge. The new south bank river wall would, he said, remove a large heap of rubble and a lot of semi-derelict buildings. The site won from the river would at first be used for the main national exhibition of the Festival of Britain, in 1951.

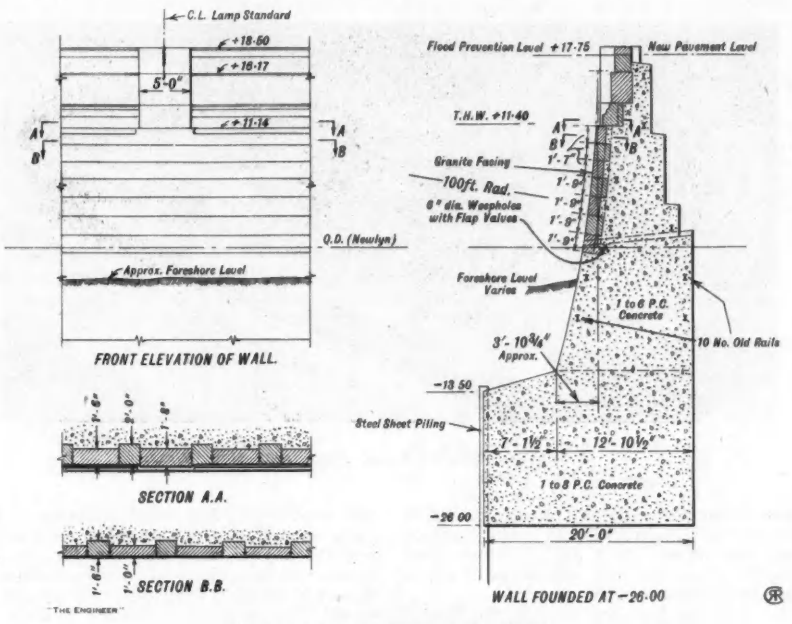
Mr. Morrison was thanked for the work he had done for South London and his part in the opening ceremony of the new south wall, by Mr. I. J. Hayward, J.P., the Leader of the Council, and by Mr. Henry Brook, M.A., the Leader of the Opposition, and he was presented with a pair of book-ends made in Cornish granite, suitably inscribed.

Some Historical Notes

In connection with the new wall an exhibition was opened in Room 150 at the County Hall on Monday. It displays old prints and photographs of the site and plans and models of the new wall, illustrating the building method and the materials to be used. Samples of the Cornish granite facing-blocks are on view and there are also samples of the river strata, as shown by borings. There is a large model of the whole of the south bank area.

The line of the river bank on the south side of the river has altered very little since Tudor days. Seventeenth-century maps show a fringe of wharves and sheds, and no permanent building was erected till in 1809 when powers were obtained to drain the site. The earliest building was Coade's artificial stone factory, built in 1769, which made ornamental stone, and had considerable vogue. It was sold and the business was removed to Somerstown in 1824. North of Coade's factory was the old Lambeth waterworks, founded in 1775, which continued to supply water for Lambeth until 1837. Another building was the India Store, built for the Government in 1862, which was later demolished. After 1820 many substantial domestic and commercial buildings were constructed in Belvedere Road, and along the river, and a number of these survived the war and the bombing.

During the excavations a careful watch will be kept for possible finds of archæological interest for the London Museum. One of our engravings shows the south bank of the river with its buildings, and its wharves, and in another engraving a typical section through the new wall is given. These drawings we would add, are only preliminary contract drawings, and they do not indicate the hand-rails, lamps, or any final details.



ELEVATION AND SECTION OF WALL

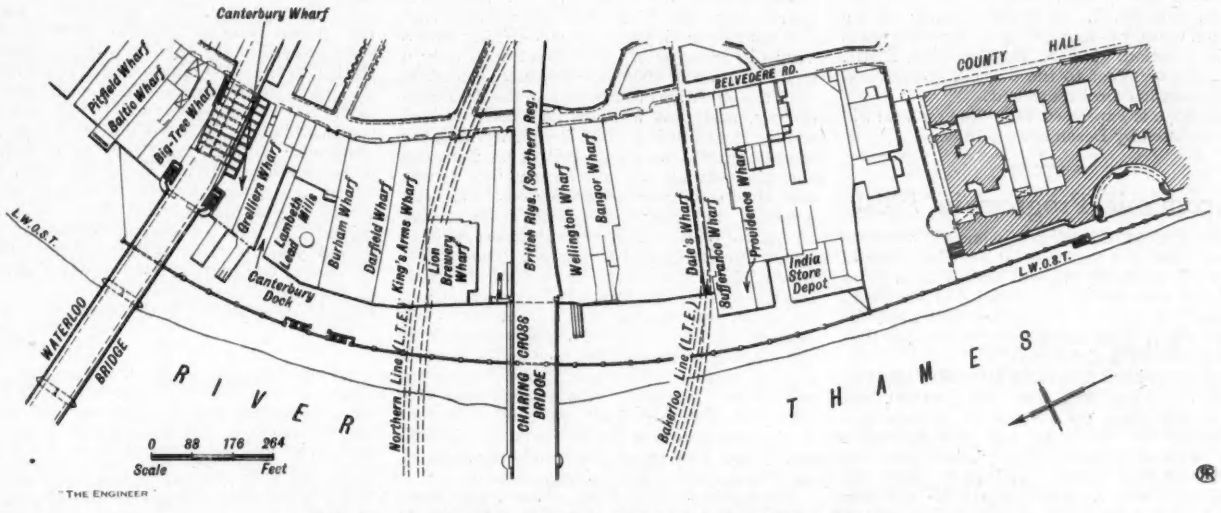
Direct access will be given to the river, by suitably placed steps, and the construction of landing-stages is also being considered. Vehicles will not be allowed on the river front.

Borings already taken by the engineers show that near the County Hall there is a thick layer of river deposit above a thin layer of ballast. Below the ballast is a large depth of London clay. Further downstream the thickness of the ballast layer increases to about 20ft. The new wall will therefore be founded on London clay from the County Hall to Jenkins Street, and thereafter on ballast.

Some Details of Construction

The new south river wall will extend from the existing wall at County Hall to a point just downstream of Waterloo Bridge. As our drawing indicates, it will follow the general curve of the river, but it will be in advance of the present river frontage, so that about four and a half acres of land will be reclaimed. Part of this land will later be laid out as an open public space. It is hoped to arrange water transport for the new site. Adjoining the open space will be Government offices, a concert hall, and a national theatre.

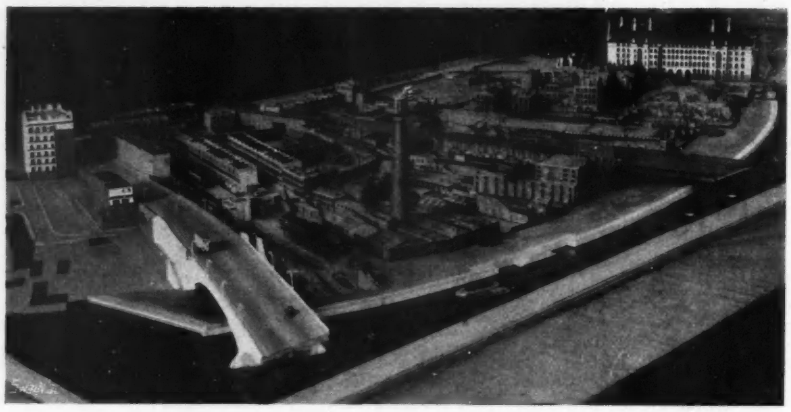
The new wall will be similar in its appearance to the existing embankments on the north bank, with their pleasing curved surface of granite. The paving of the wall will be at flood-prevention level, that is about 1ft 3in higher than the terrace of the County Hall.



MAP OF SOUTH BANK SHOWING SITUATION OF SOUTH WALL

The construction will take place inside steel cofferdams, and during the work of construction timber stagings will be erected in order to protect the work. All necessary timber, about 250 standards, was salvaged from emergency Thames bridges, which have now been dismantled. The filling behind the wall will be mainly of good hardcore, derived from demolished air-raid shelters and from the demolished buildings now piled up on the site.

Some idea of the size of the job can be obtained from the quantities of materials to be excavated and required. Some 16,000 cubic yards of material inside the cofferdams will have to be removed, including 2500 cubic yards of silt. The new materials needed include 22,000 cubic yards of concrete, 50,500 cubic feet of granite, 103,000 cubic yards of filling, and about 1575 tons of steel sheet piling for the temporary cofferdams, of which about 1000 tons will be recovered.



MODEL OF SOUTH BANK AREA AND NEW WALL

The work has been entrusted to the firm of Richard Costain, Ltd., of London, for the sum of £250,000. The granite facing blocks will be supplied from a number of Cornish quarries by Cooper Wettern and Co., Ltd., at a cost of £150,000. All the granite blocks will be prepared in Cornwall and will be shipped direct to the south bank site from Falmouth.

The design of the new wall and its plans and specifications have been prepared by Mr. J. Rawlinson, M.Eng., M.I.C.E., M.I.Mech.E., M.I.M. and Cy.E., the chief engineer of the London County Council, who will be responsible for its erection. Mr. R. H. Matthews, A.R.I.B.A., the architect to the council, has advised on the architectural treatment.

The hope is expressed that the new wall will be completed by December 31, 1950.

Economic Progress in 1948

THE United Kingdom's economic progress during 1948 was reviewed by the Chancellor of the Exchequer, Sir Stafford Cripps, at a Press conference in London on Thursday of last week. He said that, while there was still need for great effort, past achievements showed that "we were on the right path."

The provisional figures for December exports, Sir Stafford reported, were £145,700,000, and the approximate total value of exports and re-exports for the year was £1,648,000,000. The value of imports for the whole year was £2,080,000,000, which indicated that the apparent visible adverse balance for the year was £432,000,000. Sir Stafford added that information already available about the "invisible" exports showed that progress was being made to what was generally called an overall balance of payments, even though it might be some time yet before that condition was not only reached, but consolidated. The figures for last year's export trade, the Chancellor thought, were impressive. After rising in 1947 to a level of 9 per cent above the 1938 volume, the rate increased further to 30 per cent above in the first half of 1948 and to about 42 per cent above in the second half, giving an average volume for the year of about 136 per cent of 1938. In the result, the value of exports and re-exports together had been equivalent to between 85 and 90 per cent of the value of imports, compared with 72 per cent in 1947 and no more than 64 per cent in 1938. That improvement, moreover, had been achieved in the face of a continued deterioration in the terms of trade, particularly in the first half of last year.

The Chancellor continued by recalling that in October last, the index of all industrial production reached a new peak at a level 27 per cent above the 1946 monthly average. Last year, he said, was in a sense the most normal production year since the war, for the 1946 figures had been distorted by reconversion and those for the early months of 1947 by the fuel crisis. The curve of production in each year had been well above that for the preceding year, and when the figures for November and December were available, he felt that there was little doubt that 1948 would be shown to be a year of great and sustained industrial activity in this country. When it was remembered that the difficulty of shortages and controls still affected our industries, that record of increased production stood out as a very fine effort by managements and workers. On manpower movements, the Chancellor commented that the manpower situation in coal-mining was a very disturbing one. There had been only a small increase of 6000 over the year, compared with the objective of 32,000 set in the Economic Survey, and that increase had been derived wholly from the intake of foreign workers, for almost exactly as many British workers left the mines during last year as went in. It was true that the export target for coal had been achieved, but only by running down stocks, which was a method of meeting export requirements that could not be repeated. The importance of the miner's task, Sir Stafford observed, had lost nothing in magnitude or urgency during the year, and among the more encouraging features of 1948 had been a steady increase in the number of men at the face and a marked improvement in output per manshift since the end of the summer. Absenteeism was still very high, but there had been some reduction in the percentage in the last quarter of 1948, and it was hoped that that would prove to be more than a mere seasonal phenomenon.

Dealing with the subject of steel, the Chancellor said that the industry had made an outstanding contribution to the general increase in industrial output in 1948, but the demand for steel was so great that we could not be satisfied until output had been still further increased. Stocks of steel-making materials were generally rather better than a year ago, but the margin was still narrow, and to bring about the further increase in ingot production upon which so many expansion plans depended, supplies of coke, ore, scrap and pig iron must be pushed to still higher levels than they had yet reached. The degree of sustained demand for steel, the Chancellor continued, might be judged by the output of the engineering industries during last year. Production of passenger motor cars, for example, in the first eleven months was at an annual rate of 335,000, or 17 per cent above 1947, and of commercial vehicles at a rate of 170,000, or 10 per cent above 1947. The production of motor and pedal cycles had also risen steadily over the last three years. The final shipbuilding totals for the year were not yet known, but the vessels completed exceeded 1,200,000 gross tons, compared with 950,000 tons in 1947. Rolling stock production, too, had been at higher levels than in the preceding year, though locomotive production up to October had been at a lower rate than in 1946.

Turning to machinery, Sir Stafford said that there had been a general expansion in the machinery-making trades during 1948, the increase over 1947 being somewhat higher than the increase in that year over 1946. As to more specialised industrial equipment, the output of coal-mining machinery of all kinds had been at a considerably higher rate than in the two preceding years, the number of power loaders, conveyors, and underground locomotives coming forward showing a particularly marked advance. The agricultural machinery makers had also established new records, tractor production in the first eleven months reaching an annual rate of 115,000—ten times the 1938 figure and double the 1947 output. Some other striking changes had been in the output of combine harvesters, which at an annual rate of over 1000 succeeded in trebling the 1947 figure; of potato spinners, which at a rate of nearly 7750 had been half as big again, and of milking machines, which at a rate of nearly 10,400 had been nearly half as big again. Printing and bookbinding machinery production had risen from just over £3,000,000 worth before the war to £8,500,000 worth in 1947 and to a rate of £10,500,000 in 1948. There had also been striking increases in office machinery manufacture, where output had nearly doubled during last year.

Finally, Sir Stafford commented on wages in 1948, saying that the index of weekly wage rates had moved in a fashion not dissimilar from the price indices. In the five months from June to November, 1947, there had been a rise of three points. In the following three months the increase had been one point, and then—in the three quarters after the Government's appeal—the rise had been of only one point per quarter. He emphasised that at the present time any general increases which were secured could only be at the expense of the rest of the community—including, of course, all other wage earners—since such increases would not of themselves add to the volume of goods available. There was only one thing, the Chancellor added, that could do that—or, more precisely perhaps, two. The first, upon which the second largely depended, was to secure a growing volume of production by raising the level of output per head. The second was to bring about a very marked increase of our trade in hard currency markets, so as to secure essential supplies and provide a basis of improvement in the standard of living.

WASTE PAPER SALVAGE.—The Board of Trade says that there was a marked increase in waste paper collections in 1948. The total collected by local authorities and merchants was 750,000 tons, an increase of 105,405 tons over the 1947 figure. Local authorities have been set a monthly collection target of 1 ton per thousand of population, and it is stated that many are already collecting at this rate. As a further incentive, local authorities are to be offered a new collection rate of payment as from January 1, 1949. This will vary from 5s. to 20s. per ton on that part of their collections exceeding 25 per cent of the official target. The Board emphasises that waste paper is the raw material used for the production of paper boards for food and other cartons and packaging for exports. The recent increase in the size of newspapers should not be taken to imply that the need for waste paper has diminished in any way.

Continental Engineering News

Swedish Iron and Steel Industry

According to Mr. E. Wijkander, the managing director of Bofors, the modernisation and expansion carried out in Swedish mines and iron works aim not only at increased production but also the manufacture of cheaper and better steel. The development of an economic method of producing sponge iron in large quantities has for many years presented metallurgists with a difficult problem.

The methods which have been successfully tried in Sweden for some time constitute a practicable and economic solution of the problem. In these processes—the "Höganäs" and the Soderfors-Wiberg—forgeable iron is obtained directly by the reduction of the ore, the temperature being too low to allow the iron to melt. The product contains very little carbon and is not suitable for the manufacture of bar iron, but it has found its use as raw material for the production of steel by the open-hearth and electric process.

Whether sponge iron can be used with economy depends on its price and quality, as compared with those of other raw materials for steel production. There is a trend in Sweden towards a substitution of sponge iron for charcoal pig iron.

On the other hand, the Swedish mining company, Grängesbergsbolaget, put in service a new method of extracting the phosphorus from iron ore. Such ore, freed from its phosphorus content, is used for the manufacture of sponge iron destined to replace pig iron in the production of high quality steels.

Progress of Railway Reconstruction in Italy

In September, 1948, Signor G. Corbellini, Italian Minister of Transport, opened four important railway bridges: a bridge over the River Po, at Moncalieri; the Recco viaduct; a bridge over the Po, near Piacenza; and a bridge over the River Brenta.

The Moncalieri bridge, on the Turin-Genoa line, is a reinforced concrete structure, composed of five arched spans, each 72ft long, and having an overall length of 557ft (including approach spans). The viaduct over the Recco torrent, on the La Spezia-Genoa line, is a three-track railway bridge, 1312ft long. It consists of twenty reinforced concrete arched spans, 105ft and 65½ft long. The cost of the bridge amounted to 320,000,000 lire (£165,000).

The bridge over the River Po near P acenza, on the Milan-Bologna line, rep aces an iron bridge 2505ft long destroyed by bombing and mines. It consisted of eleven spans 245ft and 200ft long. For the reconstruction of the bridge, six new spans, 245ft long, were used. These spans, of the same lattice type as the pre-war bridge, were constructed in steel and gave a saving in material of nearly 400 tons. Other spans, as well as piers and abutments, were repaired.

The new bridge over the River Brenta, on the Vicenza-Treviso line, replaces an old iron bridge of thirty spans, each 39ft long, and carrying single-track line, combined side by side with a highway bridge. After the war it was decided to build a double-track railway bridge, consisting of fifteen concrete arches, each 58ft long.

A New Dam in Switzerland

In November, 1948, the Rossens dam, which blocks the valley of the Sarine River, about 10 miles above the town of Fribourg, was put into service. The new dam is a concrete arched structure, having a height of 272ft, and its crest, which is 1050ft long, carries a road linking the two banks of the Sarine River. The reservoir it impounds has an area of 3·7 square miles and a length of nearly 7 miles. The annual hydro-electric output of the Rossens dam scheme is estimated at 240,000,000kWh, and the total cost of the dam, which retains some 260,000,000 cubic yards of water, amounted to 65,000,000 Swiss francs.

The Parallel Development of Hydraulic Presses in the United States and Great Britain*

By F. H. TOWLER†

United States Presses and the Hele-Shaw Type Radial Pump

The United States was first and foremost in the development of the heavy self-contained hydraulic press, which occurred around 1926, and among the pioneers we may name Howard F. MacMillin and Walter Ernst, of the Hydraulic Press Manufacturing Company, Mount Gilead, Ohio. The development of a self-contained press entailed the employment of a high-speed hydraulic pump with a shaft speed of 400 to 1800 r.p.m., capable of reasonably high pressure, and sufficiently compact to be mounted in or on the press frame. The only pump then available was a variable-stroke radial pump invented by Dr. Hele-Shaw in the period 1914–1918, and manufactured in the United States by the American Engineering Company of Philadelphia. The construction of the Hele-Shaw pump is shown in Fig. 1, which appeared in a paper by Dr. Hele-Shaw in 1921.‡ At the outset, the Hydraulic Press Manufacturing Company employed the Hele-Shaw pump; later it manufactured a pump of similar construction. To-day, a number of firms manufacture the Hele-Shaw type of pump, and it may be said that the majority of the large self-contained hydraulic presses in the United States and Canada have been built around this type of pump. Of course, a similar development did occur in Great Britain, but not on any large scale, and, in so far as the author is aware, the Hele-Shaw pump was only applied, prior to 1926 anyway, to comparatively small presses and, in particular, to testing machines.

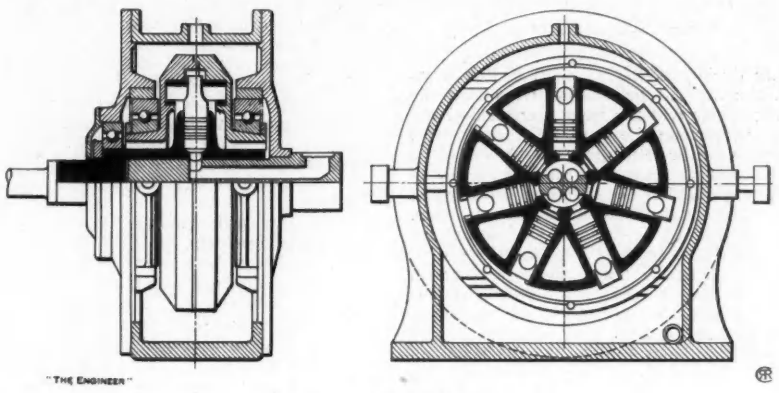


FIG. 1—*Hele-Shaw Pump*

Advantages of the Hele-Shaw Type Pump

The Hele-Shaw pump, having a pintle-type, rotary-sleeve valve, can be operated either as a pump or as a rotary motor. It was designed primarily as the component of a steplessly variable-speed gear—that is to say, by coupling a pump and motor of this construction together, and varying the stroke of displacement of one of them, it was possible to obtain infinitely variable speed of rotation at the motor shaft. Another application of the Hele-Shaw type reversible-flow, variable-stroke radial pump, which has become almost universal, is to the operation of ships' steering gear.

Limitations of the Pintle-Type Rotary-Sleeve Valve

Valve Clearance and Pump Slip or Leakage.—The pintle-type, rotary-sleeve valve imposes certain limitations on the Hele-Shaw type of pump, such that it is the author's contention that this pump is not ideal for the operation of large hydraulic presses. The periphery of the pintle throughout 180 deg., and of a length sufficient to cover the valve ports with a suitable lap, is subject to the maximum hydraulic pressure engendered by the pump. This area of the pintle is supported between two bearings upon which the pump body rotates, and therefore the pintle must deflect under the bending moment imposed by this hydraulic load. Consequently, the clearance between the pintle and valve sleeve must be sufficiently large to prevent the two coming into metal-to-metal contact due to this deflection. If the clearance is large there will be considerable valve leakage or slip; if it is too small the parts will seize. There is therefore a limitation of pressure to around 2000 lb to 3000 lb per square inch, and, in order to maintain a reasonable clearance without serious leakage, it is necessary to use a comparatively thick oil as the hydraulic medium, an oil having a viscosity around 300 Saybolt at 100 deg. Fah. Even so, after a pump of this type has been in operation for some time, the slip is in the region of 20 per cent, or, in other words, the volumetric efficiency is down to 80 per cent. It must be remembered that as the slip or leakage increases, it heats up the oil, which therefore becomes thinner and increases the leakage. A pump of 100 h.p. may be converting 20 h.p. into heating up the oil in the hydraulic system, and it is for this reason that presses equipped with this type of pump are usually fitted with cooling coils to dissipate this heat.

Thick Oil, Variations in Viscosity, Cavitation. One disadvantage of using a thick oil is that it has a wide range of viscosity, Fig. 2. Thus, one oil which is commonly used has a Saybolt viscosity of 920 at 70 deg. Fah. and 120 at 140 deg. Fah.; therefore, at low temperatures the oil may become so thick and sluggish that it will not flow into the pump chambers with sufficient rapidity and cavitation will occur. Consequently, it is frequently necessary to provide both heating and cooling coils, and thermostatic control, to maintain the oil at the desired viscosity.

The use of a thick oil also imposes some limitation on the speed at which the press ram can be operated. Most self-contained hydraulic presses are of the down-stroking type, in which the press ram comes down to meet the work, the ram falling by gravity and the press cylinder being filled with slack oil from an overhead supply tank. The oil flows into the press cylinder through a large pre-fill or non-return valve which closes when the press ram meets the work, and then the pump supplies the pressure fluid to effect the working stroke. On completion of the stroke the pre-fill valve is opened to allow the oil in the press cylinder to return to the overhead tank during the rapid return stroke of the press ram, which is effected by means of push-back rams or a return annulus to which the pump is then connected. If the oil flows freely into the press cylinder during the rapid approach stroke of the press ram, the cylinder will be completely filled when the ram meets the work, the pre-fill

* American Society of Mechanical Engineers, November 30, 1948. Abstract.

† Director, Towler Brothers (Patents), Ltd., and Electraulic Presses, Ltd., Rodley, near Leeds, England.

‡ "Power Transmission by Oil," by Dr. H. S. Hele-Shaw, "Proceedings" of the Institution of Mechanical Engineers, Vol. 2, 1921, page 849.

valve will be closed, and the pump will immediately build up pressure in the press cylinder and perform the working stroke at the required speed. On the other hand, if the pre-fill valve is too small or the oil is cold and sluggish, the press cylinder will not be filled completely when the ram meets the work; consequently, after the pre-fill valve is closed, there will be some delay while the pump fills the press cylinder prior to building up pressure and performing the working stroke. This may be referred to as "cavitation dwell." There is also some danger of air being drawn into the

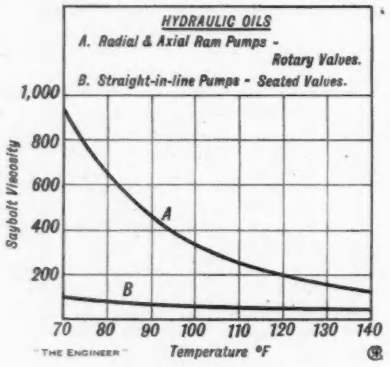


FIG. 2—*Hydraulic Oil*

cylinder during cavitation, and, if this takes place, the air will be compressed during the working stroke and the extra resilience of the liquid will impede the opening of the pre-fill valve prior to the return stroke. This may be referred to as "compression dwell."

Large Pre-Fill Valves and Pressurised Pre-Fill Tanks.—In order to avoid cavitation when using a thick oil of around 300 Saybolt at 100 deg. Fah., it is usual to make the pre-fill valve of such a size that the velocity through the valve does not exceed 5ft per second at the maximum approach speed of the press ram, assuming that the oil flows freely by gravity from the overhead tank. If the approach speed is 1ft per second, this means that the pre-fill valve must be at least one-fifth of the area of the press ram or equivalent to a pipe bore of about one-half the ram diameter, which is a very big valve. Therefore, to increase the permissible oil velocity through the pre-fill valve without cavitation, it is common practice to superimpose air pressure on the overhead supply tank. Thus, additional energy has to be expended to force a thick oil at high velocity through the pre-fill valve on the rapid approach stroke of the press ram, and similar additional energy must be expended in forcing the oil back through the pre-fill valve on the rapid return stroke of the press ram. This additional energy is converted into heating up the oil in the hydraulic system, over and above that caused by pump slip. Thus we have what might be described as an "oil-boiling system."

Speed Variation and Sustained Pressure.—Nevertheless, this system has certain advantages which, up to now, have seemed to outweigh the disadvantages. The Hele-Shaw type pump is reversible and capable of infinitely variable capacity by varying the stroke of the pump rams, so that it is possible to vary the speed of the working stroke during the pressing operation and to vary the speed of reversal and return stroke. It is also possible to maintain pressure at a given figure during the curing period of a compression moulding press by operating the pump at "near zero" delivery, so that, in effect, it is just pumping its own slip and making up any other leakage in the system; again what might be described as an "oil-boiling operation."

Uncontrolled Variations of Speed.—It should be explained that this variation in the speed of the working stroke, which is made possible by the Hele-Shaw type pump, is not independent of variations of working pressure, because of the fact that the slip varies with the pressure. Supposing that a pump of 100 gallons per minute capacity has a slip of 20 per cent at 3000 lb per square inch; then at full stroke it will deliver 800 gallons per minute against 3000 lb per square inch, and, assuming that the slip varies directly with pressure, about 90 gallons per minute against 1500 lb per square inch, so that the speed of stroke at full capacity will vary 11 per cent between 1500 lb per square inch and 3000 lb per square inch, which is sufficiently uniform for most pressing operations.

On the other hand, suppose the pump is set at "near-zero stroke," so as to give zero delivery at 3000 lb per square inch, the slip is still 20 per cent, or 20 gallons per minute at 3000 lb per square inch; therefore at no pressure it will de iver 20 gallons per minute, and 10 gallons per minute at 1500 lb per square inch, and zero at 3000 lb per square inch. Thus there is a variation of 100 per cent between 1500 lb per square inch and no pressure, which is excessive.

Let us put it another way. Suppose the pump at this near-zero stroke is operating a press through a working stroke with a maximum pressure of 1500 lb per square inch, then it will deliver 10 gallons per minute to the press cylinder at 1500 lb per square inch; but if the pressure required to do the job falls to 1000 lb per square inch during the working stroke, then the pump will deliver 13·3 gallons per minute to the press cylinder, and the speed of the pressing stroke will be increased by 33 per cent, which is not so good. On certain pressing operations, such as lead extrusion or cable sheathing, it is at the slow speeds that one requires the most accurate speed control; it is when extruding small sections with a large lead ram that the speed control must be most delicate, and a variation of 33 per cent might cause rupture of the sheath or section.

Development of Self-Contained Presses in Great Britain

The heavy self-contained hydraulic press came to be developed in Great Britain about 1934; no doubt there were earlier beginnings, but they would be isolated and mostly small presses. Nevertheless, this lag of eight years behind the parallel development in the United States had its advantages because it allowed time for the development of high-speed pumps capable of much higher pressure, 6000 lb to 7000 lb per square inch. One pump, the Paul pump,§ which came from the Continent, is of the radial type, having seated valves. It has been widely adopted, but its construction seems to necessitate the use of a thick oil similar to the Hele-Shaw pump, and it has a limiting shaft speed of around 750 to 1000 r.p.m. Also, aircocks are fitted in the end of each pump chamber to eliminate air lock, which seems to indicate that the pump is not self-priming.

Straight-In-Line Pump with Seated Valves

Another pump which is manufactured by the author and his brother, and which may account for any slight bias creeping into this paper, is a straight-in-line pump with seated valves, capable of a normal working pressure of 7000 lb per square inch with a shaft speed of 1500 r.p.m. It is made in sizes up to 150 h.p. in one unit. It has a volumetric efficiency of 97 per cent at 1500 lb per square inch; the volumetric efficiency is somewhat diminished at higher pressures, owing to the compression of the oil; but even at 14,000 lb per square inch the volumetric efficiency is in excess of 90 per cent. Pumps of this construction have been operated regularly at a momentary pressure of 12,000 lb per square inch for testing gas containers for aircraft. The mechanical efficiency is 96 per cent at 7000 lb per square inch, or maximum pump ram load. Fig. 3 shows the general construction of the pump.

Advantages and Limitations of Straight-in-Line Pump.—This pump has four limitations: it is expensive to manufacture, the stroke is not variable without considerable complication, the flow is not reversible, and it will only operate satisfactorily with a very thin oil having a viscosity around 60 Saybolt at 100 deg. Fah.

Cost of Manufacture.—It is expensive to manufacture because the three-throw pump employs two roller-bearing journals and three roller-bearing eccentrics, and the five-throw pump, in addition to the journals, employs five roller-bearing eccentrics; the eccentric bearings are "specials" because in the large pumps the ram load on each eccentric is over 3 tons. To offset this, the pump has a life of three to six years without overhaul under heavy working conditions; it will stand heavy momentary overloads of 50 to 100 per cent on occasion.

The life of the pump is determined by the roller bearings; in other words, an overhaul means a new shaft and bearings. Strangely enough, the suction and delivery valves and seats do not show much sign of wear after three to six years, provided that a thick oil is not used. This may be accounted for by the fact that at 1500 r.p.m. the valves have to make a complete cycle, open-close, in one-fiftieth of a second, and the valves are not seated under pressure for more than one-fiftieth of a second. Hence, there is always an oil film between valve and seat, i.e., there is insufficient time to squeeze it out. On the other hand, the use of a thick oil would cause cavitation and valve-hammer, with disastrous results.

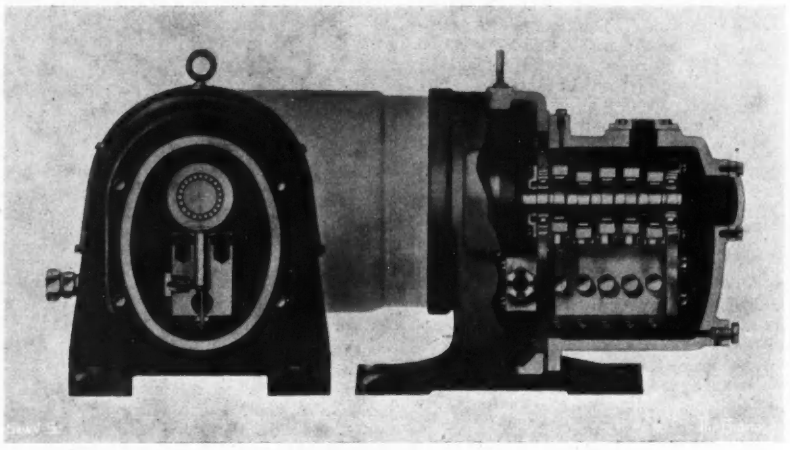


FIG. 3—*Straight-In-Line Pump*

Variation of Stroke Not Practicable.—Another limitation is that the capacity of the pump is not readily variable. However, this is not so serious as it might seem. There are many pressing operations in which it is of no advantage to vary the speed of the pressing stroke; full speed is required right through. On the other hand, with up-stroking presses and horizontal presses, a two-stage pump is most suitable. An auxiliary low-pressure gear pump or vane pump is used to effect the rapid approach

§ British Patent No. 341,667, 1929.

stroke, and a high-pressure ram pump to effect the working stroke of the press ram.

Reversing Flow by Control Valve.—In pumps of the seated-valve type, the flow through the pump is not reversible, and therefore it is necessary to use a double-acting control valve, such as that shown in Fig. 4, to control the forward and return movement of the press ram. This is not necessarily a disadvantage, because a valve spindle usually can be moved much more easily and quickly than the reversing gear of a radial or axial pump.

Controlled Steplessly Variable Capacity Without Stroke Variation.—In those pressing operations in which it is necessary to vary the speed, it is seldom essential that the speed should be steplessly variable. With a combination of three constant-delivery pumps, which may be driven by one shaft, and having capacities of 1, 2, 4 gallons per minute, it is possible to obtain seven speeds corresponding to 1, 2, 3, 4, 5, 6, 7 gallons per minute. If steplessly variable speed is essential, it is possible to bridge the gap between speeds by using a metering valve to by-pass up to 1 gallon per minute. This will give a steplessly variable-speed control which is practically unaffected by variations of pressure, because a pump, having a volumetric efficiency of 97 per cent has no appreciable slip, whereas already it has been shown that a variable-stroke pump, having a rotary valve, does not control the speed at near-zero stroke; the speed is then a variable dependent upon slip and pressure. Controlled speed is usually more important than an uncontrollably variable speed.

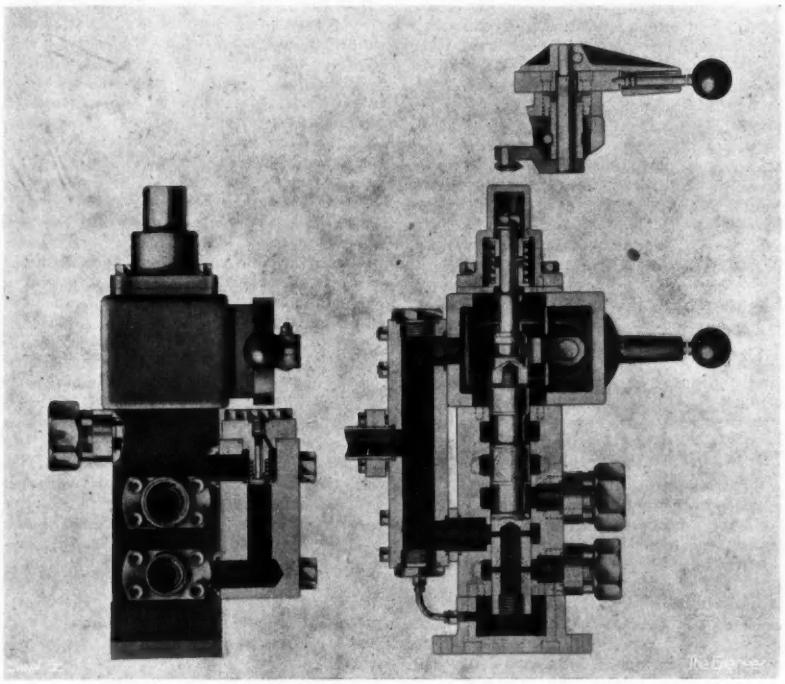


FIG. 4—*Double-Acting Control Valve*

Sustained Pressure.—This still leaves us with near-zero delivery at full pressure, such as is required to sustain pressure during the curing period of a compression-moulding press, or the clamping pressure for a die-casting or injection-moulding machine.

It has been shown previously that this near-zero delivery with the Hele-Shaw type of pump is really a quite substantial delivery, because the pump is in continuous operation, pumping its own slip in addition to making up leakage in the system. This sort of operation can be performed much more satisfactorily by a constant-delivery, straight-in-line pump provided with a pressure-actuated unloading valve which by-passes the pump to tank when maximum pressure is reached, and reloads the pump or closes the by-pass when the pressure has fallen a given amount. In this way the pump is running idle most of the time, circulating oil at tank pressure, and it is loaded momentarily at intervals to make up leakage. Furthermore, the full capacity of the pump is immediately available when required, without any stroke-changing lag. With this system, the pump is not an "oil boiler" and, therefore, no cooling coils are required.

Advantage of Using a Thin Oil.—The straight-in-line pump will only operate satisfactorily with a very thin oil. It will be obvious to anyone who has had the misfortune to read thus far that this is an almost unmitigated advantage. For what is good for the pump is good for the press. A thin oil is essential to this type of pump in order to ensure that the oil will flow freely through the spring-loaded suction valve, with the assistance of atmospheric pressure and only a few feet of head, and completely fill the pump chamber in one-fiftieth of a second. That is exactly what we want for the press. The oil must flow freely through a spring-loaded pre-fill valve into the press cylinder with the greatest rapidity under almost identical conditions, and that is what it does.

It has been proved by experiment‖ that an oil at a viscosity of 165 Saybolt will flow through a pre-fill valve at 33ft per second by gravity and with the assistance of atmospheric pressure alone, without cavitation in the press cylinder. Thus it is quite safe to allow for a pre-fill velocity of 20ft per second, with an oil of 60 Saybolt, at maximum approach speed. Even when the oil is cold and old its viscosity will not exceed 165 Saybolt—and it must be admitted that oils do get thicker after much use, due to oxidation and the assimilation of foreign matter of colloidal dimensions. Here, by way of qualification, it should be said that this type of pump is equally capable of accepting oil of a viscosity up to 165 Saybolt. It will be appreciated that one of the greatest advantages of a thin oil is the fact that it has such a flat viscosity curve, as shown in Fig. 2, so that the performance of a hydraulic press does not vary with the temperature of the oil, and there is no need for thermostatic control.

Possible Disadvantages of a Thin Oil.—A possible disadvantage of using a thin oil is that it requires very high precision in the manufacture of the packingless-piston type control valves for the press (Fig. 4).

They must be a fine lap fit, with a clearance not exceeding 1 micron per inch of diameter, in order to hold pressure satisfactorily at 7000 lb per square inch. As to press glands, there does not appear to be any greater difficulty in holding a thin oil than a thick one; furthermore, if a gland packing is good for 3000 lb per square inch, it would seem to be equally good for 7000 lb per square inch. The disadvantages of a thin oil are probably more apparent than real.

Compressibility of Oil at High Pressures.—Thin oil is slightly less compressible than thick oil, and it may be less liable to aeration; but compressibility does become more of a problem at higher pressures. As a rough approximation, oil compresses ½ per cent per 1000 lb per square inch, and therefore the energy stored in the oil at 6000 lb per square inch is twice that which would be stored in a press of the same power operating at 3000 lb per square inch. However, this is not a serious difficulty, provided proper provision is made to release this energy at the end of the pressing operation before the press ram is reversed. It should be emphasised that the actual loss of energy is usually more than offset by the saving in energy required to move one-half the volume of oil throughout the operating stroke of the press.

‖ "The Modern Direct-Hydraulic System," by F. H. Towler, "Proceedings" of the Institution of Mechanical Engineers, Vol. 154, 1946; discussion by W. F. Cully, page 190.

Oil Town in Borneo

THERE is at present under construction at Seria, Brunei, British Borneo, an oil township of more than 700 houses to accommodate the staff of the Shell Petroleum Company, Ltd., in that area. Work is also to shortly begin on a 4000ft concrete jetty, from which underwater drilling for oil will be carried out below the bed of the China Sea. This work is part of a plan for the construction of permanent buildings to replace those destroyed by the Japanese during the war and to cater for the increasing staffs engaged on expanding oil operations. The contract for the work, which has an estimated value of £1,300,000, has been placed with George Wimpey, Ltd., the building and civil engineering contractors.

Site preparation of an area of approximately 600 acres, most of it still virgin jungle, is being carried out by the oil company. The walls of the houses being built consist of "Situfoam," a material which has been developed by the contractors to meet the problem of building in remote areas, where skilled labour and normal building materials are not available. In this type of construction a mixture of sand and cement is injected with foam while it is in liquid form. The mixture is then poured into the formwork to the shape of the building required and when it sets the foam causes the formation of innumerable minute air cells in the walling. This type of wall has good insulation properties and is impermeable to moisture penetration. By use of this method of construction the walls of a building are poured directly into position on the foundations.

The contract for the Seria housing project is scheduled for completion in just over three years. Construction of the marine jetty will be undertaken concurrently with the housing project, and is expected to be completed by mid-1950 at a cost of £100,000. More than 3000 tons of concrete will be used in this work, over 400 reinforced concrete piles being required in the jetty alone. When the jetty is completed, work will begin on the drilling of four wells of about 10,000ft depth, to appraise the offshore prospects. Upon the results of these wells, plans will be formulated to drill further wells to develop the area.

A TUNGSTEN CARBIDE GLASS CUTTER.—A new glass cutter with a tungsten carbide wheel is about to be placed on the market by Euco Tools, Ltd., 44, London Road, Kingston-on-Thames. This new cutter will be known under the trade name "Karbo." It has a die-cast body of non-ferrous alloy, in which the wheel is mounted on a copper spindle. The new tool can also be used for cutting glazed tiles, and is claimed to be able to cut some 4 miles of glass during its working life.

Industrial and Labour Notes

Industry and the Profits Tax

THE Federation of British Industries has sent to the Chancellor of the Exchequer a memorandum setting out some detailed opinions on the profits tax. During the passage of the Finance Bill last year, it was pointed out that the profits tax, apart from other objections, falls on the ordinary shareholder, a circumstance which might have a distorting effect on the finance of companies. The Chancellor undertook to reconsider the tax from this aspect before the 1949 Budget, and as a result the F.B.I. was requested to submit its views.

The memorandum emphasises that the burden of profits tax falls solely on the ordinary shareholder, who has to bear, in addition to his own share, that of the preference shareholders. It singles out corporate income for taxation and cannot be passed on in the same manner as income tax, thus constituting a burden on corporate savings. Furthermore, the F.B.I. memorandum says, the profits tax encourages the financing of companies by debentures, income notes, or loans from banks or institutions, interest on which is regarded for tax purposes as an expense. The drift towards financing by borrowing, it is urged, is harmful because it exposes businesses to failure at times of adverse trading experience. Reference is also made to the idea of a ceiling to the effective rate of profits tax which would mitigate the severity of the tax on the ordinary shareholder where there are preference shares.

In presenting its memorandum, the F.B.I. has explained that it has always been opposed to the whole idea of the profits tax, and the fact that it is now making some detailed criticisms should not be taken "as in any way indicating that its attitude to the tax in general has weakened." The memorandum concludes by suggesting three alternatives, as follows:—To abolish the profits tax completely, and to restrict the tax on corporate earnings to the general income tax; to restrict the profits tax to a distribution tax on ordinary and participating non-cumulative preference dividends; or to restrict the profits tax to distributions and to give an option to the Crown either to levy the general distribution rate on equity dividends as included above—that is, 25 per cent or such lower rate as may be fixed—or, alternatively, to levy at a lower rate, say, 10 per cent, on the sum of the equity dividend and the fixed preference dividends. This option would operate where the preference dividends are one and a half times as much as the ordinary dividend.

Railwaymen's and Busmen's Wage Disputes

At the end of last week, the Minister of Labour stated that the National Arbitration Tribunal had expressed the opinion that, by virtue of agreements between the parties, suitable means already existed for the settlement of the disputes over a wages claim between the National Union of Railwaymen and the Railway and London Transport Executives. Acting on this advice, the Minister has therefore decided to refer the disputes for settlement by the machinery constituted in accordance with the agreements in question, and has notified all the parties accordingly. The Minister has decided also to refer the dispute between the N.U.R. and the Docks and Inland Waterways Executive to the machinery of the railway industry. The existence of a dispute, it will be recalled, was notified to the Minister following the rejection by the Executives of a claim advanced by the N.U.R. for an increase in railway wages of 12s. 6d. a week.

Another announcement by the Ministry of Labour says that an independent tribunal has been set up to consider a claim by the Transport and General Workers' Union for pay at the rate of time and a half on Saturdays after 1 p.m. for the road-operating and semi-skilled and unskilled maintenance staffs of the London Transport Executive. Mr. John Cameron, K.C., is the chairman of the tribunal, the other members being Lord Burnham, vice-chairman of the Newspaper Proprietors' Association, and Mr. J. Bowman, a vice-president of the National Union of Mineworkers. The terms of the tribunal provide that it shall "make an award which shall be binding upon the parties, as if it were an award made under the Conditions of Employment and National Arbitration Order of July 18th, 1940."

The Engineering-Legal Society

The growing complexity of law in its relation to engineering, and the increasing attention which engineers in senior executive positions have to give to legal questions, have led to the formation of a society devoted to this special branch of law. The society is known as the Engineering-Legal Society, and membership is open to those, qualified in law or engineering, who are interested in the law affecting all branches of the engineering industry. Sir John Dalton has been appointed chairman of the Society, the committee of which includes Mr. R. Birt, Mr. C. L. G. Fairfield, Mr. E. J. Rimmer, and Mr. H. E. Spicer, with Mr. R. Baldwin as honorary secretary.

The Society is holding a dinner on Thursday next, January 27th, at which Mr. G. P. Barnett, H.M. Chief Inspector of Factories, will speak on "The Factories Act and the Engineer." Particulars of this event and of the Society may be obtained from Mr. R. Baldwin, *The Electrical Times*, Sardinia House, Sardinia Street, London, W.C.2.

The Coal Industry

A meeting of the coal industry's joint national negotiating committee, which consists of representatives of the National Coal Board and the negotiating committee of the National Union of Mineworkers, was held in London on Wednesday of last week. Amongst the matters discussed was the claim put forward by the National Union of Mineworkers for an additional week's holiday with pay. It was stated that the National Coal Board felt bound to reject the claim, having regard to the loss of coal which would be involved and the cost which the Board would have to bear. The union indicated, however, that it would have to consider taking the claim to the National Reference Tribunal. The Committee also discussed, at the suggestion of the union, the setting up of a working party to ascertain facts upon which a miner's pension or superannuation scheme could be based. The National Coal Board is making available to the union certain relevant information, but made it clear that it was not in any way committed to the acceptance of a scheme.

Figures relating to coal production, which are published every week by the Ministry of Fuel and Power, show that in the first week of the new year, ended January 8th, the total saleable output of coal was 3,717,500 tons, of which 3,624,400 tons were deep-mined. The amount lost through recognised holidays, disputes and breakdowns during that week is put at 371,700 tons, a figure which, however, does not include loss caused by absenteeism. Last week's output is provisionally estimated at 4,235,700 tons, of which 4,061,000 tons were deep mined and 174,700 tons opencast.

Employment and Unemployment

The latest report issued by the Ministry of Labour on the employment situation in Great Britain relates to November last, when the total working population of the country was 20,377,000, an increase of 16,000 (10,000 less men and 26,000 more women) compared with the preceding month. The number of people in civil employment during November was 19,222,000, of whom 5,691,000 were women. Employment in the country's basic industries declined by 8000 in November, there being a seasonal decrease of 5000 in agriculture, and decreases of 4000 in transport and shipping, and 400 in coalmining, but an increase of 1000 in the number employed in public utilities. In the manufacturing industries there was an increase during November in the number employed of 22,000, bringing the total at the end of the month to 7,364,000. Of this number, 2,914,000 were at work in the metals and engineering group of industries, an increase since the preceding month of 7000. In the building and civil engineering industries, employment declined in November by 14,000 to 1,362,000. Other items in the Ministry's report are that the size of the Forces increased during November by 13,000, giving a total of 810,000, and that the number of foreign workers placed in employment was 3200 compared with 8900 in October and 9900 in September.

The Ministry has also issued this week the latest available statistics of unemployment which show that on December 6th there were 327,213 people registered as out of work, compared with 327,943 on November 13th. The number of men of eighteen and over included in the December unemployment figure was 238,931. It is stated that the total includes 39,089 married women, many of whom are probably retiring from industry, and 6904 ex-Service personnel who had not by December 6th taken up any employment since leaving the Forces.

Iron and Steel Prices

The Minister of Supply has made the Control of Iron and Steel (No. 68) Order, 1949, which amends the maximum prices of certain iron and steel products. The principal alterations are in the prices of galvanised sheets (thinner than 3mm) which are increased by 65s. a ton basis; galvanised hot finished tubes, increased by 35s. a ton; galvanised wire nails, increased by from 6s. 6d. to 17s. 6d. per cwt; stainless steel and iron, the basic prices of which are increased by from ¼d. to ¾d. per pound, according to quality; and nickel bearing alloy steels, the prices of which are increased by varying amounts according to quality. These amended prices, it is explained, follow the recent increase in the prices of spelter, nickel and chrome.

Production Problems

The Manchester Chamber of Commerce has just received the annual report of its Engineering and Metals Section, which observes that, within the limits imposed by national economic policy and planning, the engineering industries have continued to expand production to meet the pent-up demand from the war years for capital equipment and consumer goods, both at home and overseas. But so far as production is concerned, the report goes on, the engineering industries have still to contend with shortages of raw materials and consumer products which are limiting or impeding full output in many sections. Furthermore, the achievement of the highest levels of efficiency to ensure a continuous expansion of production is conditioned by the overall problems of manpower, statutory measures of control and restriction, resources to finance the replacement of capital equipment and stocks, taxation, research and other factors arising from current economic conditions and national policy.

The report stresses that the solution of those problems is both vital and urgent in the national interest. Their burden upon industry has become more apparent with the growing realisation on all sides that the country has entered upon the most critical phase of its economic rehabilitation. It is to the credit of all concerned, the report comments, that recent months have witnessed concerted action over a wide field to introduce or initiate remedial measures. In the former category, it is suggested that the engineering industries will benefit from the further relaxation of statutory controls on the manufacture and supply of a wide range of machinery, plant and appliances, which came into effect on December 1st.

French Engineering News

(From our French Correspondent)

A number of French industrialists have been notified by Ruhr coal exporters that exports will be undertaken as from the first quarter of 1949. The Ruhr mines had a daily output of 325,000 tons in November, and this figure was maintained in December. Total output from the Ruhr in November was 7,710,000 tons, compared with the 1938 monthly average of 11,250,000 tons. Production costs have risen considerably due to high costs of materials, wages and maintenance work, and most of the coking plants are working at a loss. The German offer concludes by pointing out that the programme includes fuel, fertilisers, cement and iron.

* * *

The Communist paper *l'Humanité*, has reported that a spokesman of the Hamburg Chamber of Commerce has declared that the French Navy could place orders for 100,000 tons of shipping in the bi-zone once the prohibition enforced by the Potsdam agreement is lifted. He added that French experts have already been examining this possibility. Official French circles deny all knowledge of this and there is a general feeling that orders should not be placed in Germany while there is a danger of unemployment in French shipyards. The *Merchant Navy Journal* states that conversations are at the moment taking place between England and America by which vessels would be constructed in Germany either for Germany or other countries, particularly Scandinavia, with steel supplied from America. This would be contrary to the quadripartite naval agreement signed after Potsdam, which limits tonnage constructed in Germany to 1600 tons. Until now, new construction has been for 1200 to 1500 ton units and 400-ton trawlers, there being a total of 15,000 tons under construction.

* * *

The Air Ministry is considering the construction of foreign designs of aeroplanes, owing to a lack of French prototypes of an international class. It is thought that a licence to produce British de Havilland "Vampires" will be sought. Certain reductions to be undertaken in aircraft plants in the future will reduce the number of workers from 30,850 to 20,000 and the number of plants from thirty-five to twenty. Construction of high-powered engines is to be encouraged, even for medium-sized machines. Authoritative circles have denied the likelihood of extensive denationalisation of the industry.

* * *

The deficit in the budget of Electricité de France for the year 1948 was six milliard francs, but this was due to the deficit in gas exploitation, which is administered under the same head. The nationalised mine deficit amounted to 20 milliard francs, of which 9 milliards was due to the strike. The S.N.C.F. deficit is 28 milliard francs, and the Air France deficit is 1 milliard francs, making a total deficit of 55 milliard francs for the nationalised industries.

* * *

The prohibition on using copper for electric cables, conductors, and some other parts used in electric plant has led to certain difficulties, because working methods have to be adjusted accordingly. It is now being asked whether the relatively modest allowance of copper, which has been replaced by aluminium, would not be a more paying proposition from the national point of view, as output is being affected by the substitution.

* * *

French oil refining capacity increased in 1948 from 7 to 12 million tons, which compensates for the loss of 12,000 tons' capacity, due to the closing of the Courrieres and Saint-Hilaire refineries. The Minister of Public Works has stated that France can only produce a small quantity of synthetic fuel at prohibitive prices. It is therefore considered preferable to concentrate on developing refineries capable of producing cheaper fuel and providing work for French labour.

Notes and Memoranda

Air and Water

THE SNOWY RIVER POWER AND IRRIGATION SCHEME.—The Australian Prime Minister has announced that a report on a scheme to harness the waters of the Snowy and other rivers of the Australian Alps has been submitted for consideration by the Federal Government and the Governments of Victoria and New South Wales. The plan provides for the waters of these rivers to be diverted to hydro-electric generation and thence to irrigation areas, and the estimated power output is 1,750,000kWh. The cost of the project is put at between £166,000,000 and £185,000,000.

PORT FACILITIES FOR RIO DE JANEIRO.—It is reported that a contract has been placed for the construction of a new pier and warehousing facilities at the port of Rio de Janeiro. The pier will be 400m long and 80m wide and will have a low-water draft of 13m, which it will be possible to increase to 14m at a later date. Sufficient berthing facilities will be available for six medium-sized ships, four large vessels or two ocean liners. Two three-storey warehouses will be constructed, besides railway lines, and runways for lorries and motor-cars. The pier will be situated at the foot of the main Avenida Rio Branco and the whole scheme is expected to be completed within two years.

WATER SUPPLIES IN EAST AFRICA.—The Colonial Office reports that important advances are being made to assist Africa's search for water. Following the recent report on the Water Resources of the Bechuanaland Protectorate, Northern Rhodesia, Nyasaland and Tanganyika, Kenya and Uganda —in which Professor Debenham, Professor of Geography at Cambridge University, called for the training of "hydrological engineers"—there is news of progress carried out with money provided under the Colonial Development and Welfare Act. In the three years 1945–48 the Uganda Geological Survey has put down 500 boreholes and erected 200 dams, and in Northern Rhodesia the geological unit has sunk forty-nine boreholes, and in the past two years nineteen dams have been built. The Colonial Office adds that by boring on new and better land the experts are now making it possible for the Africans to move to new areas. The direct result has been not only increased production of maize, but, in Eastern Province for example, the spreading out of African agriculturists and a notable amelioration of their previous crowded conditions. African maintenance teams are now being trained and are taking over care of the boreholes. Similar developments are taking place in Tanganyika as a prelude to the extension of cattle raising.

Miscellanea

LONDON TRANSPORT ALUMINIUM ALLOY TRAINS.—London Transport Executive has announced that an order has been placed for ninety aluminium cars, expected to enter service on the District Line in two years' time. They will be the first lightweight rolling stock to be used in Britain, and will be made by the Metropolitan-Cammell Carriage and Wagon Company, Ltd., at an estimated cost of £1,250,000. Each car will be more than 3 tons lighter than the steel cars now in use. There will result a considerable saving in steel.

LECTURES ON ELECTRONICS IN INDUSTRY.—A special course of six lectures on electronics in industry will be given on Fridays at 6.30 p.m., starting February 4, 1949, at the Polytechnic, Regent Street. The lecturer will be Mr. L. I. Farren, of the research laboratories of the General Electric Company, Ltd., and the syllabus will cover fundamentals, ultrasonics, high-frequency heating, and control systems. Enrolment forms for the course (fee 10s.) can be had from the Head of the Electrical Engineering Department, The Polytechnic, Regent Street, London, W.1.

COALFIELD SURVEY IN SOUTH WALES.—Prospects of securing quantities of coal hitherto believed to be unworkable, lying between Tondu, near Bridgend and Port Talbot, in the South Western Division of the National Coal Board, are revealed in a detailed investigation, which has been reported by Dr. A. M. Woodland, of the Geological Survey. Although there are many problems yet to be solved before definite conclusions can be drawn as to the practicability of raising this coal on an economic basis, it is believed that modern mining technique may now make it possible to exploit the many millions of tons of first-grade quality coal. In this area, along the South Crop, in the Tondu-Margam line, the measures dip northward up to 30 deg.—or 21in to the yard. The increase in depth as the seams are followed is, therefore, very rapid. The main coals have been extensively worked from drifts along the South Crop, and all the collieries there have exploited the coals down to considerable depths, where the difficulties of haulage and ventilation make economic workings impossible. Vast reserves of coal were known to lie beyond the old workings but these were believed to have been at excessive depth. The position to the west was even more discouraging and to the north the coal plunged to unworkable depths. Dr. Woodland's investigation has revealed the probability of a wealth of coal along a plane which radically alters the whole prospect of mining in the district.

GOVERNMENT DEPARTMENT ELECTRICAL SPECIFICATIONS: G.D.E.S. 22: 1948, FOR WIRES. The Committee on the Standardisation of Electrical Cables and Wires for Government Services (Secretary, Ministry of Supply, Inspectorate of Electrical and Mechanical Equipment, "Walsingham," Chislehurst, Kent) has recently issued a revised version of G.D.E.S. 22: 1948, for equipment wires. Some types and sizes of wires and cables have been deleted from the previous issue and a number of other minor modifications have been made. Copies can be obtained from H.M. Stationery Office, price 3d.

LONG-SERVICE RECOGNITION.—The directors of Robey and Co., Ltd., have accepted a scheme, prepared by the company's board of co-operation, to provide a certificate and token gift to each employee with thirty-five years' or more service. The gift will be cumulative year by year after the thirty-fifth year of service, and each further five years a new certificate and the accumulated gift will be presented. The first awards under the scheme were made recently to ten employees with fifty years or more service; twelve with 45–49 years; twelve with 40–44 years, and twenty-one with 35–39 years' service.

EXTENSION OF CEMENT WORKS.—Strict conditions have been imposed by the Minister of Town and Country Planning in giving permission to the British Portland Cement Manufacturers to extend the Hope Cement Works in Derbyshire. The conditions include control of the emission of fumes and their dispersal by the erection of a 400ft chimney, the submission of detailed plans of buildings, the planting of trees to screen the works, and the creation of artificial lakes in places where clay has been excavated. The Minister's decision follows a local inquiry which was held last April, when the question was raised whether further industrial expansion in an area famous for its beauty and recommended by the Hobhouse Committee as suitable for a national park was desirable.

A 600-kW STAND-BY GENERATOR.—A 900 h.p. diesel engine driving a 600-kW generator has been installed at the Mitcham Works of Philips Electrical, Ltd., in a specially-built power-house. Night workers will be relieved for day duty by the provision of this equipment, as its output is about one-quarter of daytime consumption. The 900 h.p. diesel component was designed and used as one of a pair of propulsion units in a tank landing craft; it weighs over 15 tons and was purchased in the U.S.A., no suitable equipment being obtainable quickly in this country. The Philips plant department at Mitcham constructed all accessory equipment, such as switchboard, control panels, cables and connectors, and piping. For the storage of fuel a tank with a capacity of 28,000 gallons has been provided. Further stand-by power arrangements have been made at other factories of the Philips group: for example, at Balham and at Brixton, stand-by plant of 100kW and 60kW capacity respectively is installed.

BRITISH ELECTRICITY AUTHORITY ENQUIRY BUREAU.—The British Electricity Authority Enquiry Bureau, housed at 164, Great Portland Street, W.1, deals with telephone and in-person enquiries from members of the public, firms and other bodies connected with the industry, other outside bodies, and from within the industry itself. The Bureau is able, from its own records and without infringing on functions proper to the Area Boards, to answer immediately a fair range of questions about addresses, office-holders, organisation and the like, and otherwise to advise to whom an approach should be made, whether in the B.E.A. or the Area Boards. It is a strict and sensible rule that in B.E.A. matters outside the scope of its directory and information resources the Bureau either refers the enquirer to the relevant department or, where appropriate, obtains the information from that department. A large wall-map mounted on birds-eye maple veneer shows the boundaries of the fourteen areas, and the location of the major power stations, whilst larger-scale maps of the areas are housed in a map cabinet.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Chemical Society

Fri., Jan. 28th.—King's College, Newcastle-upon-Tyne, "Three and Four-Membered Heterocyclic Rings," F. E. King, 5 p.m.

Incorporated Plant Engineers

Thurs., Jan. 27th.—S. YORKS. BRANCH: Grand Hotel, Sheffield, "Mechanical Straightening," G. J. Wilkes, 7.30 p.m.

Mon., Jan. 31st.—W. AND E. YORKS. BRANCH: The University, Leeds, "Non-Ferrous Metals," Mr. Irvine, 7.30 p.m.

Institute of British Foundrymen

To-day, Jan. 21st.—FALKIRK SECTION: Temperance Cafe, Lint Riggs, Falkirk, "Core Shop Practice," A. L. Mortimer, 7 p.m.

Sat., Jan. 22nd.—BRISTOL BRANCH: Grand Hotel, Broad Street, Bristol, "Loam Moulding," W. H. Hornby, 3 p.m.——BURNLEY SECTION: Grammar School, Blackburn Road, Accrington, "A Day in the Foundry," R. Yeoman, 6.15 p.m.

Wed., Jan. 26th.—LONDON BRANCH: Waldorf Hotel, Aldwych, W.C.2, "Synthetic Resin Core-Binders," G. L. Harbach, 7.30 p.m.

Fri., Jan. 28th.—W. WALES SECTION: Baldwin's Canteen, Landore Works, Swansea, "The Production of High Quality Castings," J. D. T. Yuille, 7 p.m.

Sat., Jan. 29th.—WALES AND MONMOUTH BRANCH: Engineers' Institute, Cardiff, Film, "Aluminium Castings Production," 6 p.m.

Institute of Marine Engineers

To-day, Jan. 21st.—Tech. Institute, Falmouth, "The Importance of Scientific Training for the Young Marine Engineer," J. Paley Yorke, 7.30 p.m.

Tues., Jan. 25th.—The L.C.C. School of Engineering and Navigation, Poplar, London, E., "Non-Ferrous Metals in Marine Engineering," G. T. Callis, 7.30 p.m.

Institute of Metals

To-day, Jan. 21st.—SHEFFIELD LOCAL SECTION: Grand Hotel, Sheffield, "Thermocouples," R. C. Jewell, 6.30 p.m.

Institute of Welding

Wed., Jan. 26th.—Institution of Civil Engineers, Great George Street, S.W.1, The Sir William J. Larke Medal Paper, 6 p.m.

Institution of Chemical Engineers

Fri., Jan. 28th.—N.W. BRANCH: College of Technology, Manchester, Annual General Meeting, "The Place of Heterogeneous Equilibrium in Chemical Engineering," F. A. Freeth, 3 p.m.

Institution of Civil Engineers

Tues., Jan. 25th.—Great George Street, S.W.1, "Trend of Hangar Design," J. B. F. Hawkins, 5.30 p.m.——NEWCASTLE-UPON-TYNE AND DISTRICT ASSOCIATION: North of England Institute of Mining and Mechanical Engineers, Westgate Road, Newcastle-upon-Tyne, "The Civil Engineer and the Glacial Age," A. Raistrick, 6.15 p.m.

Fri., Jan. 28th.—YORKSHIRE ASSOCIATION: Royal Victoria Station Hotel, Sheffield, "Site Investigations, Including Boring and Other Methods of Sub-Surface Exploration," H. J. B. Harding, 7 p.m.

Institution of Electrical Engineers

Mon., Jan. 24th.—Informal Meeting: Savoy Place, Victoria Embankment, W.C.2, Discussion on "Generation of Electricity by Gas Turbine Plant," opened by L. J. Cheshire, 6 p.m.——N.E. CENTRE: Neville Hall, Newcastle-upon-Tyne, "Sub-Stations with particular Reference to Yorkshire Practice," L. H. Fuller and C. R. Clarke, 6.15 p.m.

Tues., Jan. 25th.—MEASUREMENTS SECTION: Savoy Place, Victoria Embankment, W.C.2, Discussion on "Improved Methods of Meter Testing," opened by H. S. Fetch, 5.30 p.m.——N. MIDLANDS CENTRE: Yorkshire Electricity Board, 1, Whitehall Road, Leeds, 1, "The Flash Tube and Its Applications," J. N. Aldington and A. J. Meadowcroft, 6.30 p.m.——S. MIDLANDS CENTRE: Town Hall, Birmingham, Faraday Lecture, "Television," Sir Noel Ashbridge, 6 p.m.

Wed., Jan. 26th.—RADIO SECTION: Savoy Place, Victoria Embankment, W.C.2, "The Development of Magnetic-Tape Recorders," E. M. Payne, 5.30 p.m.

Institution of Engineers and Shipbuilders in Scotland

Tues., Jan. 25th.—39, Elmbank Crescent, Glasgow, "Notes on Trawl Fishing," D. B. Cunningham, 6.30 p.m.

Institution of Heating and Ventilating Engineers

Tues., Jan. 25th.—SCOTTISH BRANCH: Engineering Centre, 351, Sauchiehall Street, Glasgow, C.3, "The Heat Pump and Its Industrial Applications," Robert Hendry, 7.30 p.m.

Wed., Jan. 26th.—LIVERPOOL AND DISTRICT BRANCH: Radiant House, Bold Street, Liverpool, "Hot Water Supply Systems," S. F. Greenland, 6.30 p.m.

Institution of Mechanical Engineers

To-day, Jan. 21st.—Storey's Gate, St. James's Park, S.W.1, "Marine Engineering in the Royal Navy," Eng. Vice-Admiral Sir John Kingcome, 6 p.m.

Sat., Jan. 22nd.—YORKSHIRE BRANCH, GRADUATES' SECTION: Great Northern Victoria Hotel, Bradford, "The Training of Apprentices, With Particular Reference to the Requirements of the Precision Machine Tool Industry," H. Bailey, 2.30 p.m.

Mon., Jan. 24th.—N.E. BRANCH: News Theatre, Pilgrim Street, Newcastle-upon-Tyne, "Britain's Energy—A New Conception," Sir Claud D. Gibb, 6 p.m.——YORKSHIRE BRANCH: Royal Victoria Station Hotel, Sheffield, Annual General Meeting, 6.30 p.m.

Tues., Jan. 25th.—BIRMINGHAM CENTRE, AUTOMOBILE DIVISION: James Watt Memorial Institute, Great Charles Street, Birmingham, "The Influence of Valve-Port Design on the Volumetric Efficiency of the Compression-Ignition Engine," C. B. Dicksee, 6.45 p.m.

Wed., Jan. 26th.—WESTERN BRANCH, GRADUATES' SECTION: Merchant Venturers' Tech. College, Unity Street, Bristol, "Some Notes on the Manufacture and Use of Drop Forgings," K. L. Buckle, 7 p.m.

Thurs., Jan. 27th.—N.W. BRANCH: Engineers' Club, Albert Square, Manchester, Annual General Meeting, "Heat Engines," K. Baumann, 6.45 p.m.——SOUTHERN BRANCH: Municipal College, Portsmouth, "Marine Engineering in the Royal Navy," Eng. Vice-Admiral Sir John Kingcome, 6.30 p.m.——WESTERN CENTRE, AUTOMOBILE DIVISION: Royal Hotel, Bristol, "Basic Problems in the Engineering of a Modern All-Metal Motor Body," E. S. White, 6.45 p.m.

Fri., Jan. 28th.—Storey's Gate, St. James's Park, S.W.1, "The Application of Free Jets to the Mixing of Fluids in Bulk," H. Fossett and L. E. Prosser, and "Investigations into Cyclone Dust Collectors," A. J. ter Linden, 6 p.m.

Sat., Jan. 29th.—N.E. BRANCH, GRADUATES' SECTION: Visit to the Woollen Mills of Paton and Baldwins, Ltd., Darlington, 10.30 a.m.

Institution of Works Managers

To-day, Jan. 21st.—MANCHESTER BRANCH: Engineers' Club, Albert Square, Manchester, "Britain's Industrial Future," L. C. Ord, 6.30 p.m.

Mon., Jan. 24th.—GLASGOW BRANCH: Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, "Lighting as an Aid to Production," C. J. King, 7 p.m.

Junior Institution of Engineers

To-day, Jan. 21st.—S. MIDLAND GROUP OF MEMBERS: High School, Alexandria Avenue, Luton, "The Production and Uses of Industrial Precious Stones," N. J. Bowyer-Lowe, 7.30 p.m.

Sat., Jan. 22nd.—N.W. SECTION: 16, St. Mary's Parsonage, Manchester, "The Engineering Approach to Photography," L. H. A. Carr, 2.30 p.m.

Mon., Jan. 24th.—SHEFFIELD AND DISTRICT SECTION: Metallurgical Club, West Street, Sheffield, Ordinary Meeting, 7.30 p.m.

Manchester Association of Engineers

Fri., Jan. 28th.—Engineers' Club, Albert Square, Manchester, "Refrigeration as Applied to Food Preservation," A. B. Edwards, 6.45 p.m.

Manchester Statistical Society

Fri., Jan. 28th.—Society of Architects, 16, St. Mary's Parsonage, Deansgate, Manchester, "The Design of Some Simple Physico-Chemical Experiments," G. P. Sillitto, 6.45 p.m.

North East Coast Institution of Engineers and Shipbuilders

Fri., Jan. 28th.—Bolbeck Hall, Newcastle-upon-Tyne, 1, "Vibration Diagnosis in Marine Geared Turbines," H. G. Yates, 6.15 p.m.

North Western Fuel Luncheon Club

Wed., Jan. 26th.—Engineers' Club, Albert Square, Manchester, "The Romance of Hydrogenation," R. Holroyd, 12 noon.

Royal Aeronautical Society

Thurs., Jan. 27th.—Institution of Civil Engineers, Great George Street, S.W.1, "Radar as an Aid to the Study of the Atmosphere," F. E. Jones, 6 p.m.

Sheffield Metallurgical Association

Tues., Jan. 25th.—198, West Street, Sheffield, 1, Annual General Meeting, 7 p.m.

Society of Instrument Technology

Wed., Jan. 26th.—Royal Society of Tropical Medicine and Hygiene, Manson House, Portland Place, W.1, "Interference Films on Glass and Their Use in Optical Instruments," K. M. Greenland, 6.30 p.m.

Contracts

THE WELLMAN SMITH OWEN ENGINEERING CORPORATION, Ltd., has received an order from John Summers and Sons, Ltd., for two 250 ton and two 125-ton heavy-duty ladle cranes, 78ft span, for its new steel plant. The 250-ton cranes will operate in the casting bay and the 125-ton cranes in the furnace bay.

ASHMORE, BENSON, PEASE AND CO., Ltd., Stockton-on-Tees, has been awarded two blast furnace contracts. The first is from the Polish Government and is for equipment for a furnace designed by the firm's American associates, the Freyn Engineering Company. The second contract is for the rebuilding of the No. 1 furnace of the Cargo Fleet Iron Company, Ltd. This will be the second furnace at this plant to be modernised and the work forms part of the overall plan for the extension of the British Steel Industry.

Personal and Business

MR. E. S. WADDINGTON has been elected President for 1949 of the Society of Engineers.

MR. W. G. GORHAM has been appointed general manager of Dunlop Special Products, Ltd.

MR. ANDREW BLYTH has been appointed general manager of William Mills, Ltd., Wednesbury.

MR. REX BATE has been appointed sales director of Brush Electrical Engineering Company, Ltd.

MR. R. V. ARNFIELD, A.R.I.C., has been appointed development engineer of Ray-Heet Company, Ltd., Leatherhead.

MR. F. W. TRIBBLE has been appointed technical representative in S.E. England of The Aerograph Company, Ltd.

MR. MAURICE NACHSEN, M.I.C.E., M.I.Struct.E., consulting engineer, has moved his office to 58, Victoria Street, Westminster, S.W.1 (telephone, Victoria 0353).

THE VAUGHAN CRANE COMPANY, Ltd., has opened a branch office at Princes Chambers, 6, Corporation Street, Birmingham, 2 (telephone, Midland 3933), under the management of Mr. H. L. B. Christy.

THE DOCKS AND INLAND WATERWAYS EXECUTIVE announces the following appointments: Mr. S. M. Sewell, docks manager, King's Lynn, and Mr. R. Buttery, docks superintendent, Goole.

MR. R. BROOKS, who retires from the Metropolitan-Vickers Electrical Company, Ltd., on January 31st, relinquished his position as chief engineer, Control Department, as from December 31, 1948.

THE LONDON MIDLAND REGION OF BRITISH RAILWAYS announces the following appointments: Mr. E. H. Baker, assistant divisional motive-power superintendent, Derby, and Mr. A. S. Turner, assistant to district traffic superintendent (operating), Chester.

TRUE SCREWS, Ltd., announces that its sales organisation has been transferred to the works at Britannia Street, Aylesbury, Bucks (telephone, Aylesbury 1066). A skeleton staff will remain at the London office at St. George's House, 193–7, Regent Street, W.1, to deal with urgent enquiries.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., announces the following appointments: Mr. W. T. Gray becomes chief engineer traction control department (including railway signals and heating element sections); Mr. G. L. Newman becomes chief engineer, industrial control (including electronic control); Mr. A. D. Ferguson and Mr. C. M. Sayer become assistant chief engineers of traction control and industrial control departments, respectively; and Mr. S. A. Ghalib becomes engineer in charge, electronic control.

COVENTRY GAUGE AND TOOL COMPANY, Ltd., Coventry, and The Rockwell Machine Tool Company, Ltd., Rockwell House, Second Way, Exhibition Grounds, Wembley, Middlesex, announce the conclusion of an agreement with the American Broach and Machine Company, Ann Arbor, Michigan, U.S.A., for the manufacture of "American" broaching machines in this country. To begin with the patent Three-Way Pull, Push and Surface Broaching Machines and certain sizes of horizontal hydraulic machines will be manufactured and the range extended as circumstances demand. The machines will be sold and serviced by Rockwell Machine Tool Company, Ltd., which will also continue as the representative of the American Broach and Machine Company, in this country.

HENRY SIMON, Ltd., announces that, owing to rapid expansion of business in recent years, certain changes in organisation have been made for the sake of administrative efficiency. The firm has hitherto been both a trading and a holding company, carrying on the two principal businesses of mechanical and pneumatic handling, and flour and provender milling engineering and soap-making machinery, and it also has several other departments and owns a number of subsidiary companies. The two main departments have now been turned into separate trading companies. The former conveying department becomes Simon Handling Engineers, Ltd., while the milling department and soap machinery department continue to be called Henry Simon, Ltd. The parent company, Henry Simon (Holdings), Ltd., completely owns and guarantees the two trading companies and will function as a holding company for the co-ordination of general policy. It is emphasised that the reorganisation involves no change whatever in general policy and personal relations with clients, and that the management remains in the same hands as hitherto. The board of Simon Handling Engineers, Ltd., consists of the management board of the parent company, with Mr. I. Hey, M.Sc., Tech., M.I.Mech.E., as managing director and with the addition of Mr. F. Raby Jolley, M.Sc., A.M.I.Mech.E., and Mr. J. R. Rowlands, M.I.Mech.E.

A Seven-Day Journal

The Ardler Junction Collision Report

THE report of Brigadier C. A. Langley, Inspecting Officer of Railways, to the Minister of Transport on his inquiry into the collision which occurred at 5.8 p.m. on July 17, 1948, at Ardler Junction, near Perth, on the double-track main line in the Scottish Region, British Railways, has now been published by the Stationery Office. It will be recalled that the 3.30 p.m. up postal express from Aberdeen to Glasgow was travelling on the up main line under clear signals at a speed of about 70 m.p.h., when it came into converging collision with the 4.20 p.m. passenger train from Dundee West to Blairgowrie, which had overrun the branch line home signal which was at danger. Driver J. Laing, of the Dundee train, and fireman J. Smith, of the Aberdeen express, died of their injuries, and six passengers and one railway servant were detained in hospital, while five other passengers were injured. Both main lines, including the crossover road and junction connections were destroyed for about 100 yards, but were reopened to traffic thirty hours later, the branch line connections being completed about July 23rd. After hearing the evidence, Brigadier Langley says that he is satisfied that the Ardler Junction up main signals were clear for the Aberdeen express, and that the Dundee train passed the branch home signal at "danger." That was, he says, the immediate cause of the accident, for which the late driver J. Laing must be held responsible. He finds also that signalman J. B. Patton was seriously to blame for allowing two trains simultaneously to approach a converging junction in contravention of block regulations. While not criticising the siting of the Ardler Junction up home signals, the Inspector suggests that consideration should be given to making the branch distant signal a working signal. Normally, on that branch, trains were run through the junction under clear signals and were not held at the home signal except on rare occasions. In such circumstances, it would appear that the fixed arm may have become to be disregarded as a warning of the aspect of the signals ahead, and may have come to be considered as a location mark only.

London Fire Brigade Developments

ON Friday, January 21st, at the London Fire Brigade Headquarters, Albert Embankment, London, S.E.1, it was announced by Mr. I. J. Hayward, the Leader of the Council, who was supported by Mr. R. Sargood, the chairman of the L.C.C. Fire Brigade Committee, that the Committee has recommended the Council to adopt a long-term policy of gradually abolishing the street fire alarms, which are to be replaced by the "999" emergency telephone call. Street fire alarms were first installed in London in 1880, and by 1937 the system had been extended to 1727 fire alarm points. Operation on the open circuit gave many false calls owing to mechanical breakdowns. Between 1938 and 1943 the fire alarm system was changed to a closed system, which almost entirely eliminated false calls arising from mechanical defects. With the development of telephone services, there was an increasing use of the telephone for fire calls, as well as, and eventually in place of, the street fire alarm. The number of telephone calls received by the Brigade rose from 64 in 1903 to 7783, over half the calls by all methods, in the last ten months of 1948. The calls received by exchange telephone are now averaging about 800 a month. The L.C.C. Fire Brigade Committee has recently reviewed the value of the street fire alarm system, taking into consideration the sharp increase lately in false alarms by this system. From March 1 to December 31, 1948, no less than 75 per cent of the fire calls given by street fire alarms in the County of London were malicious false alarms. Of all malicious false calls no less than 84·79 per cent were made by street fire alarm as against only 15·21 per cent given by telephone. The cost of maintaining the street alarm system is £23,000, to which must be added about 64,000 man-hours for testing, cleaning and painting. The Post Office is collaborating with the Fire Brigade in making the change by installing new public call offices. All incoming "999" calls are received on a special switchboard at Brigade Headquarters by trained operators. The problem of street location has been overcome by the use of specially prepared cards filed on drums, giving information for every London street, so that when a "999" call is used drivers are given the actual address of the fire.

Traffic Arrangements for the 1951 Exhibition

IN the House of Commons on Wednesday, January 19th, the Public Works (Festival of Britain) Bill was introduced by Mr. Alfred Barnes, the Minister of Transport. It will give the London County Council and the British Transport Commission powers to carry out certain works which need Parliamentary authority. The cost of the proposed works is not expected to exceed £2,000,000, and the Bill provides that the Minister may, with the consent of the Treasury, make grants towards expenses incurred by the L.C.C. or the B.T.C. in connection with Exhibition traffic arrangements. Expenditure incurred purely for Exhibition purposes may be borne by the Exchequer. The principal works aim at giving direct access to the main Exhibition on the South Bank of the Thames, by road, rail and water. They include footbridges to bring visitors over the river from Charing Cross Underground Station, and to link the Exhibition with the Waterloo main line station. New railway subways and escalators are to be constructed on the Underground Railways at Charing Cross Station and at Waterloo, giving better access to the Exhibition site and allowing passengers to reach the street level without having to use the railway platforms. For road traffic new parking places will be established during the Exhibition on Clapham Common, in the Geraldine Mary Harmsworth Park, and on bombed sites. Traffic measures will include the enlargement of the centre island in Parliament Square, and the construction of traffic roundabouts at both ends of York Road. The carriageway in Wellington Street, near the Strand, will be widened. Frequent water bus services will, if the present plans mature, bring large numbers of visitors to the Exhibition by the river; the Thames Passenger Services' Interest Committee is working out details of this scheme. In the meantime the L.C.C. has been given powers to build piers giving direct access to the Exhibition.

Ross-shire Hydro-Electric Scheme

ON Friday last, January 21st, the second largest electricity scheme of the North of Scotland Hydro-Electric Board was approved by the Secretary of State for Scotland. The scheme has been confirmed by the Secretary of State, in an Order presented to Parliament, and the £8,700,000 project can be begun after the scheme has lain before Parliament for forty days provided that the Confirming Order is not annulled by resolution in the House of Commons or the House of Lords within that period. In an article published in our issue of March 5, 1948, we described the scheme and gave a map of the projected lay-out of the dams and power stations, with impressions of the completed works. The Glascarnoch-Luichart-Torr Achilty project, Constructional Scheme No. 16 in the Board's programme, includes a further development of that part of the county of Ross and Cromarty already covered by the Loch Fannich programme. The latest scheme covers an area of 345 square miles, and will develop all the water power resources of the rivers Conon, Meig, Bran, Glascarnoch, and their tributaries, also the upper catchment area of the River Carron and the River Broom. It involves the building of eight dams and the construction of four generating stations with a total installed capacity of 60,000kW. Prolonged negotiations with the fishery boards in the districts affected has resulted in amendments to the scheme as originally published to give more protection to the fisheries.

The Institute of Transport Silver Jubilee Scholarship

THE Council of the Institute of Transport invites application from its members for the 1949 award of the Silver Jubilee Scholarship, which has a value not exceeding £150. It is announced that consideration will normally be given to only those applications which involve an aggregate of at least three months' absence, in periods of not less than a month each, from the candidate's employment. The purpose of the scholarship, it is pointed out, is to assist the selected member to meet expenses incurred in travel for the purpose of studying transport, specific projects for transport research, or full-time education at a university or other educational institution approved by the Council. Candidates for the scholarship must have passed the Graduateship Examination of the Institute, but preference is likely to be given to one who has passed the Associate Membership Examination, and who is not over 30 years of age. The holder of a scholarship either for travel or research, will be required on the expiration of its tenure, to make a report to the Council on the work he has carried out. Applications must be made on a form which may be obtained from the Secretary of the Institute of Transport at 80, Portland Place, London, W.1, with whom it must be deposited not later than May 31st. Each application must be supported by a member (M. Inst. T.) of the Institute, who can personally vouch for the suitability of the applicant.

Mr. James Calderwood's New Appointment

IT is announced that Mr. James Calderwood, M.Sc., has resigned his position as manager of the diesel and marine department of Sulzer Brothers (London), Ltd., to join Associated British Oil Engines, Ltd., as its technical director. Mr. Calderwood takes up his new appointment on February 1st, and he will be in charge of all design and development work at each of the five factories of the company in which Mirrlees, McLaren, Petter and Petter-Fielding oil engines are at present being built. Mr. Calderwood received his early practical training with Swan, Hunter and Wigham Richardson, Ltd., and he studied at Armstrong College (now King's College), Durham University, gaining his M.Sc. degree. Towards the end of the 1914–1918 war Mr. Calderwood served as an engineer officer in rigid airships of the Royal Air Force. His first appointment after the war was as assistant to the technical manager of Swan, Hunter and Wigham Richardson, Ltd., and was concerned with research and development of the steam turbine and the marine oil engine. In 1923 Mr. Calderwood was appointed assistant works manager at the Neptune Engine works of the same firm. Four years later he came to London as assistant manager of the diesel department of Sulzer Brothers (London), Ltd., and in 1934 he was appointed manager of the diesel and marine department of the firm, having charge of all the Sulzer diesel-electric locomotive, marine and stationary diesel engine work carried out in this country. Mr. Calderwood is the author of several important papers dealing with heavy-oil engines and gas turbine and vibration problems. He is a valued member of the Institute of Marine Engineers, the Institution of Naval Architects, the North-East Coast Institution of Engineers and Shipbuilders, and the Junior Institution of Engineers. He is also an Associate Fellow of the Royal Aeronautical Society.

Progress in the British Steel Industry

A FORTNIGHT ago it was announced that steel production in Great Britain during 1948 reached the record figure of 14,877,000 tons. Not only, therefore, did it exceed, with a handsome margin, the Government's revised target of 14,500,000 tons, but it also represented by far the highest annual output ever achieved in the history of the industry. For some months past it has been evident that the 1948 target would be passed, and there will be general agreement with the Chancellor of the Exchequer, who, in reviewing economic progress, said a few days ago that "the steel industry has made an outstanding contribution to the general increase in industrial output in 1948; indeed, the efforts made by steel workers and managements alike provided one of the brightest features of the year." It may be mentioned, in passing, that in paying this well-deserved tribute, the Chancellor made no reference to the effect upon the steel industry of the Bill now before Parliament!

There are, naturally, various factors which have contributed to the success attained by the steel industry last year. The hard work of managements and men was not hampered by labour troubles, the best possible use was made throughout the year of existing production capacity, there was no serious dislocation of transport, and supplies of raw materials—although still a cause for anxiety—were considerably better than in the two preceding years. In this connection, an outstanding feature of the year was the success of the industrial home scrap drive, which yielded 4,550,000 tons, and exceeded by nearly 1,000,000 tons the estimate made in the Economic Survey. Receipts of imported scrap showed improvement towards the end of the year, when they were running at an annual rate of approximately 1,000,000 tons. It seems highly probable that for the next two or three years the difficulties of increasing ore and coke supplies will make it necessary to rely largely on bigger imported scrap deliveries to secure a high level of steel output. But substantial quantities of scrap from Germany are unlikely to be available for more than a few years, and in the more distant future therefore, it is hoped to expand pig iron, production to a level which would make scrap imports unnecessary.

At the same time the British Iron and Steel Federation has warned that the raw material factor most likely to limit steel output is the supply of coke. Although coke consumption per ton of iron has fallen from 22 cwt in 1946 to 20·5 cwt in 1948, and is expected to decline to 19 cwt by 1953–1955, there is still a need for a further 3,000,000 tons of coke, which in its turn involves an expansion of nearly 5,000,000 tons of coking coal. The Federation points out that the main expansion in coke oven capacity is taking place at the iron and steel works, but although work is progressing, the time required for coke oven building is so prolonged that there may well be difficulties in coke supply, particularly between now and 1953, when additional blast-furnace and steel capacity will be coming into operation. Although no substantially increased demands for coke are being placed on the National Coal Board ovens, the age of many of those ovens suggests that an extensive rebuilding programme has become necessary and it is obviously important that that work should proceed in parallel with coke oven expansion at blast-furnaces. As well as the matter of coke oven capacity, there is, of course, the equally important need for adequate quantities of good quality coking coal.

Steel production in 1948, however, has benefited from the progress made with some of the extension and modernisation schemes included in the programme which the industry adopted and which the Government approved in May, 1946. This programme, it may be recalled, aimed at expanding the capacity of the steel industry from 14,100,000 tons to 16,000,000 tons, or at increasing production from the 1946 level of 12,750,000 tons to between 15,000,000 tons and 15,500,000 tons on the completion of the programme, which was to be spread over five to seven and a half years. The intention was to begin all the extension and reconstruction schemes within the five years 1946–1950, but, in view of the length of time required to complete some of the major schemes, it was stated that the plan was unlikely to be completed and give full results until 1953. The total building of steel-making capacity arranged for by the programme was approximately 6,000,000 tons, of which 4,000,000 tons would be for replacing existing plant and 2,000,000 tons for expansion. Since the programme was first drawn up—more than three years ago—many changes have occurred in the outlook for British industry generally and, consequently, in the outlook for the steel industry. The demands of the export trade, combined with increasing home needs, have led a Government committee, on which the steel industry was represented, to estimate that by about 1953, if full employment is maintained, steel requirements will be in the neighbourhood of 18,000,000 tons a year.

The probability of such an event was not overlooked in the preparation of the plan for the steel industry's development, and in fact provision was made for a considerable element of flexibility in case bigger outputs should be required. Actually it has been possible to make sure that there will be sufficient capacity available to meet the anticipated increased demand for steel, although, of course, it is by no means easy to determine that there will be sufficient raw materials to make use of it. Broadly speaking, however, the readjustment of the original programme involves, not a substantial increase in new building, but employing the 6,000,000 tons of new capacity in such a way as to enable 4,000,000 tons of extra output to be secured, and to provide 2,000,000 tons for replacement. Moreover, a change of this nature in the balance between expansion and replacement is not inappropriate when it is borne in mind that the increase in the cost of new plant over the last three years has been so great that, in several branches of steel production at any rate, no economy would be shown at present in incurring major capital expenditure on new plants merely to replace existing capacity.

In calculating ways and means of expanding steel capacity, consideration was naturally given to factors which have already made a significant contribution to the improved outputs of the last year or so. Two such factors which may be mentioned are the adoption of the continuous working week in the steel-melting shops and the changeover in a number of plants to oil-firing. So far as the former is concerned, the possibility of the continuous working week was foreshadowed in the original development programme and the hope was expressed that the arrangement might enable more than 500,000 tons and possibly as much as 750,000 tons additional output to be obtained from a given capacity. As to the latter factor, it is estimated that the use of oil-firing has now been extended to about a quarter of the industry as a means of increasing output from furnaces of a given size by more rapid melting.

Work on Development Projects

As has already been suggested, steel production last year was undoubtedly assisted by the early effects of some of the new projects included in the steel industry's development programme. The work completed during 1948 included a new ore preparation plant at Corby, coke ovens at Consett, blast-furnaces at the Clyde ironworks of Colvilles, Ltd., at the works of the Consett Iron Company, and at the Margam works of the Steel Company of Wales, Ltd., and a new melting shop at the Appleby-Frodingham works of the United Steel Companies, Ltd. Plant which it is expected will come into operation in the course of this year includes the new ore-unloading and treatment plant of Dorman, Long and Co., Ltd., new melting shops and mills at the Brierley Hill works of Round Oak Steelworks Company, Ltd., and works associated with the new continuous billet mill and wire rod mill of John Lysaght, Ltd., at Scunthorpe.

More detailed reference to the progress of some of these projects is made at a later stage of this review, but an idea of the magnitude of the task which the steel industry has undertaken is conveyed by the following summary of major schemes completed and in hand, which has been prepared by the British Iron and Steel Federation and which is included in the current number of its *Monthly Statistical Bulletin*. It may be added that over two-thirds of the total expenditure involved under the programme has now been approved in detail by the Iron and Steel Board and construction work on at least half the schemes is in hand.

Major Schemes Completed and in Hand

Stewarts and Lloyds, Ltd., Corby: New coke ovens and ore preparation plant complete. New open-hearth melting shop, additional tube plant and mill reconstruction in progress. Site preparation begun for new blast-furnaces, Bessemer plant and continuous billet mill.

Lancashire Steel Corporation, Ltd., Irlam: New coke ovens and ancillary plant. Site preparation begun for new wire rod mill.

Richard Johnson and Nephew, Ltd., Manchester: Reconstruction of wire rod mill completed.

John Summers and Sons, Ltd., Shotton: New melting shop, modernisation of mills and ancillary plant in progress. Erection of new coke ovens, ore unloading and preparation, new blast-furnaces.

United Steel Companies, Ltd., Scunthorpe: New melting shop completed. Modernisation of mills and ancillary plant, new coke oven battery, new ore preparation plant.

John Lysaght, Ltd., Scunthorpe: New coke oven battery, provision of ore crushing plant and services, erection of new blast-furnaces, rebuilding of open-hearth plant, new cogging mill, continuous billet mill and continuous wire rod mill.

Richard Thomas and Baldwins, Ltd., Scunthorpe: New ore preparation plant, new blast-furnaces, electrification of mills.

Consett Iron Company, Ltd., Consett: New coke ovens completed. New ore unloading plant, new blast-furnace, reconstruction of open-hearth shop and reheating furnaces, and new slabbing and blooming mill.

Darlington and Simpson Rolling Mills, Ltd., Darlington: New section mill completed.

Dorman, Long and Co., Ltd., Cleveland: New ore unloading, preparation and sintering completed. Two new blast-furnaces.

Dorman, Long and Co., Ltd., Lackenby : Site work commenced for new open-hearth shop and broad flange beam mill.

Skinningrove Iron Company, Ltd., Saltburn : New blast-furnace, new steel furnace, improvements to rolling mills.

South Durham Steel and Iron Company, Ltd., West Hartlepool : Extension and enlargement of melting shop, reconstruction of cogging mill.

Colvilles, Ltd., Clyde Ironworks : New coke ovens. New blast-furnace completed. Ancillary plant.

Colvilles, Ltd., Clydebridge : Extension of melting shop and installation of open-hearth tilting furnaces for hot metal.

Stewarts and Lloyds, Ltd., Clydesdale : Reconstruction of melting shop, partial completion.

Stewarts and Lloyds, Ltd., Mossend, Calder and Tollcross : New installation and reconstruction of tube plant.

Round Oak Steelworks, Ltd., Brierley Hill : New melting shop, replacement of cogging mill and finishing mill well in hand.

Stewarts and Lloyds, Ltd., Bilston : Ore handling equipment.

Stewarts and Lloyds, Ltd., Halesowen and Bromford : Modernisation of tube plant.

Steel Company of Wales, Ltd., Margam : New ore unloading and preparation plant, new coke ovens, new blast-furnaces, new melting shop, continuous hot strip mill and cold reduction mill.

Steel Company of Wales, Ltd., Trostre : New cold reduction mill.

Richard Thomas and Baldwins, Ltd., Ebbw Vale : New coke ovens, additional open-hearth steel furnace, new electrolytic tinning plant.

John Baker and Bessemer, Ltd., Rotherham : New open-hearth furnace.

English Steel Corporation, Ltd., Sheffield : Reconstruction of foundries and ancillary plant, installation of new electric furnaces.

Firth-Vickers Stainless Steels, Ltd., Sheffield : Reconstruction of mills and ancillary plant.

Arthur Lee and Sons, Ltd., Sheffield : Reconstruction of mills and ancillary plant.

Park Gate Iron and Steel Company, Ltd., Rotherham : New ore handling equipment.

United Steel Companies, Ltd., Treeton : New coke ovens.

United Steel Companies, Ltd., Rotherham : Modernisation of mills and ancillary plant.

United Steel Companies, Ltd., Workington : Ore preparation plant, modernisation of rail finishing equipment.

Throughout last year, progress continued to be made on the extensive reconstruction project announced by the Steel Company of Wales, Ltd., in February, 1947. As the foregoing summary indicates, this project involves the construction at Margam, South Wales, of new ore unloading and preparation plant, new coke ovens and blast-furnaces, a new melting shop, and the erection of a new 80in continuous hot strip mill and a cold reduction mill. The project includes also the erection of a cold reduction plant and tinplate works at Trostre, Llanelly.

The first part of the scheme—work on which was begun at the end of April, 1947—is now well in hand. In the existing Margam works new sidings have been laid for the reception of coal, iron ore and limestone; work on the construction of wagon tipplers is progressing, and the erection of the conveyors for raw materials has begun. Twelve of the first eighteen blending bunkers of a new coal washery have now been completed as far as bunker-top level, the remainder being in various stages of construction from the hopper bottoms. Among the tasks involved in this part of the scheme is the removal of an existing railway embankment, which cuts through the site of the washery.

It is intended to build ninety new coke ovens at Margam, and of these the foundations of the first group of thirty are now nearing completion, while for the second group, the north buttress wall is about two-thirds finished, together with some of the sub-structure. The No. 2 blast-furnace, with a hearth diameter of 16ft, has been dismantled and work has begun on the erection of a new 25ft 9in hearth furnace. The foundation block to carry the new furnace has been completed and base plates have already been located. Considerable progress has also been made on the piling and foundations for the main structure of the cast house building. Whilst work on the excavations for the new skip pit was proceeding, there was an uncontrollable influx of dock water, which necessitated the undertaking of a freezing process. Although it is likely to take four months to complete this process, it is not expected that the date planned for the completion of the furnace will be affected.

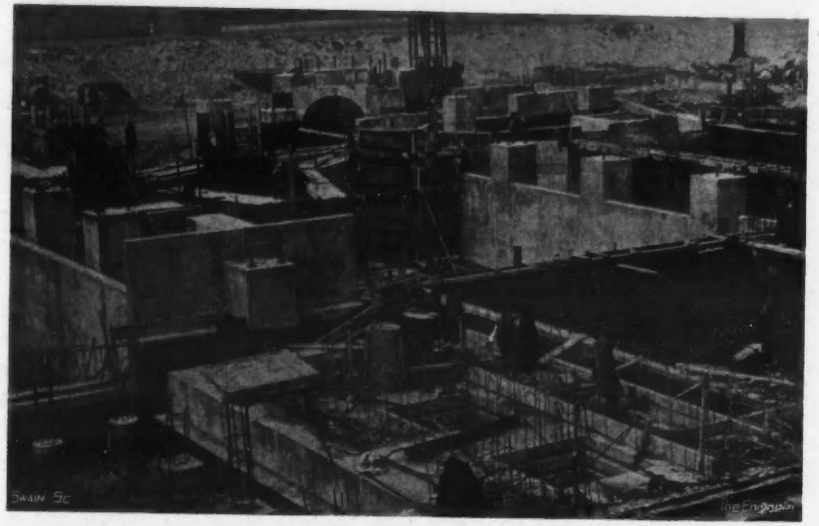
Other work proceeding at Margam includes the installation of additional power plant, an extension of the gas-cleaning plant, and an extension of the wharf for carrying the low-level transfer cars along the ore stockyard. A new pig-casting machine which is being erected on a site between Margam and the Port Talbot works, is expected to be ready for operation by the end of February, and in the melting shops the existing open-hearth furnaces are being replaced. One of these new furnaces has been operating since February of last year, and a second is almost ready to go into service. In addition, the extensive alteration of railway tracks to conform with the new lay-out of the works has necessitated the erection of five bridges. Three have already been completed, and work on the other two is advancing.

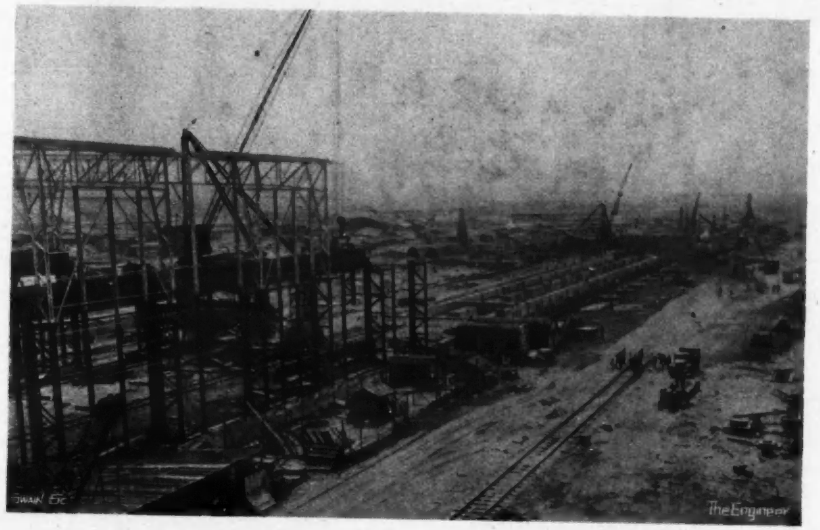
On the Abbey Works site at Margam, where the new 80in continuous strip mill is to be built, there has been considerable activity during the past year. The site is the long, narrow foreshore of Swansea Bay, extending from Port Talbot in the direction of the historic Margam Abbey. Here, work is, of course, still proceeding on the transportation of filling to raise the level of the site, but good progress has also been made with pile-driving and foundation work. An indication of the work already accomplished is given by the fact that 3,257,375 cubic yards of sand and slag have been laid as filling, 20,157 piles have been driven, 5633 tons of steel reinforcement and 130,984 cubic yards of concrete have been placed, and 3415 tons of steelwork have now been erected.

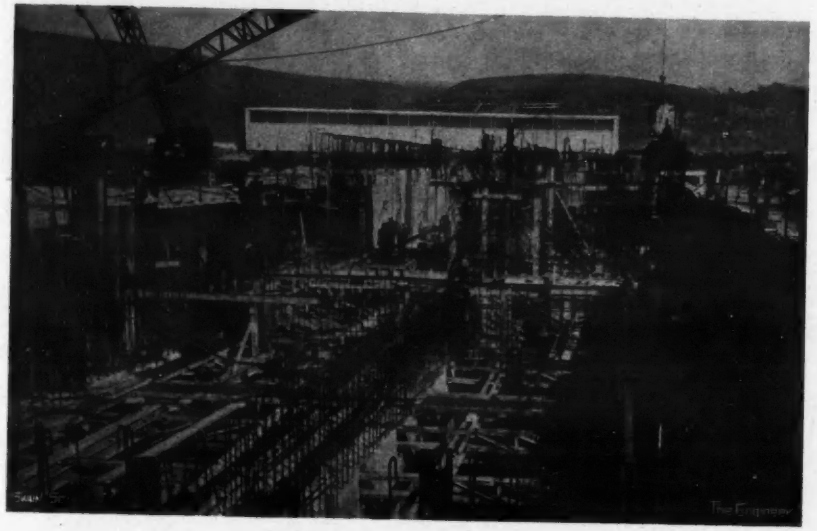
MOULD PREPARATION BAY—ABBEY WORKS OF THE STEEL COMPANY OF WALES

On the next page there are reproduced some photographs which convey an idea of the progress on the Abbey Works project, while the engraving on this page illustrates the mould preparation bay, which is now virtually complete. This building, it may be mentioned, is being used by Dorman, Long and Co., Ltd., as a fabricating shop for the exceptionally heavy steelwork to be erected in the adjoining melting shop. Work already carried out on the melting shop includes the foundations of the first eight of the 200-ton furnaces which will be employed. As shown by the engravings on the next page, steelwork erection for the new melting shop has begun, one of the girders fabricated weighing 90 tons and measuring 110ft by 12ft 5in deep by 3ft wide. This is the first of twenty-two similar girders needed for the melting shop. At the ingot stripper and soaking pit building, the foundations of the soaking pits have been completed and the steelwork of the building is in process of

PROGRESS OF THE ABBEY WORKS AT MARGAM OF THE STEEL COMPANY OF WALES, LTD.







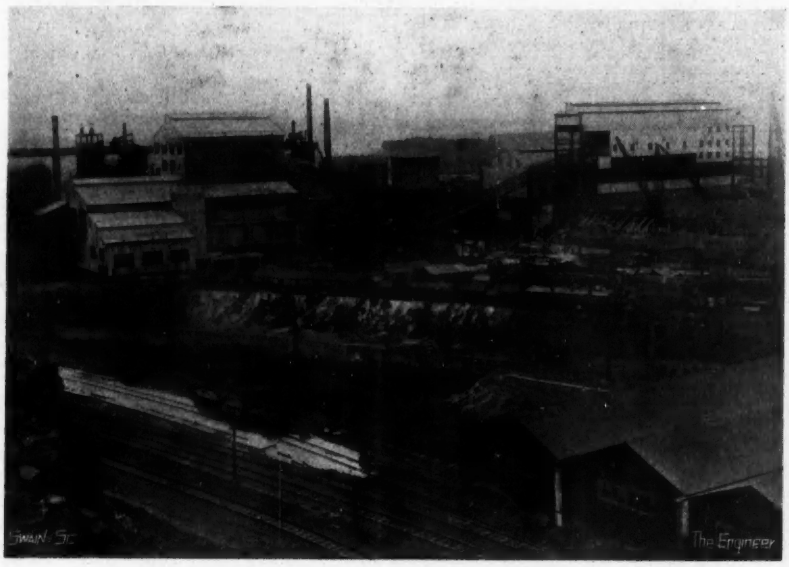
MELTING SHOP FOUNDATIONS.
SOAKING PITS, FOUNDATIONS AND SLABBING MILL AREA

MELTING SHOP FURNACE FOUNDATIONS
MAIN PUMP HOUSE

erection. The soaking pits' chimneys are also now being built.

Most of the foundation work required for the slabbing mill area is finished and the foundations for the continuous strip mill are making good progress. Towards the end of the year civil engineering work was started on the site of the new cold reduction mill, and concrete for the building column bases is now being poured. A permanent connection with the Western Region of British Railways is in operation, and work on site railways has advanced to a stage which will shortly enable temporary connection to be made with the main railway line.

Finally, when the Margam project was approved, it was agreed that some of the necessary equipment must be obtained from the U.S.A. Three shiploads of this plant have already arrived and the equipment, which includes some of the heaviest pieces, is being stored at the site.



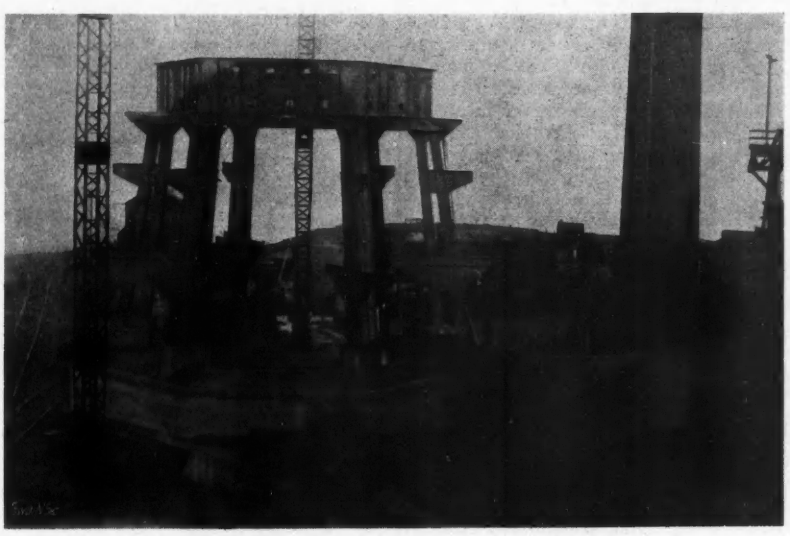
CONSTRUCTION OF ORE PREPARATION PLANT—CLEVELAND WORKS

The engravings, Figs. 6 and 7, illustrate two of the projects which are among those in progress on the North-East Coast. The first of these is the ore-unloading, ore-preparation and sintering plant which is being completed at the Cleveland works of Dorman, Long and Co., Ltd. It will be appreciated that this project has involved a large amount of civil and structural engineering work, the major part of the plant manufacture and installation having been carried out in the firm's constructional shops and by its bridge and contracting department.

A new riverside berth, 520ft long, has been added to the Eston Wharf at the Cleveland works, resulting in a total length of 2098ft becoming available for the accommodation of ore-carrying ships. The equipment of the new berth includes two high-capacity ore-unloaders, each weighing 700 tons and capable of discharging 350 tons of ore an hour. Improved unloading and stocking arrangements for imported ore, as well as new gravity-feed sidings for home ore, are practically complete, and work is well advanced on the equipment of the ground bunkers, crusher house, ore-screening and bunker house, and sinter plant. Electric locomotives will transport the ore from the wharf to the ore-stocking gantry, which has a capacity of 220,000 tons, or, alternatively, direct to ground bunkers. From this stage to delivery at the Cleveland blast-furnaces, all the ore will be handled by belt conveyor over a distance of 3200ft.

The new plant is designed for an annual throughput of over 2,000,000 tons of imported and local home ores, and is intended to serve the blast-furnaces at all the Dorman, Long works, including the new unit which it is planned to provide at the Cleveland works. During the past year a link has been provided between the company's Cleveland and Redcar works by the construction of 3 miles of private railway.

Another development in the North-East Coast area is the construction of a 21ft hearth diameter blast-furnace at the works of the Skinningrove Iron Company, Ltd., near Saltburn. The furnace will be of the most modern type, the ore being handled through wagon tipplers and crushers and conveyed by belt to the bins. The engraving, Fig. 7, illustrates the state of the work at the furnace site at the end of 1948. The work of extending the melting shop building and installing a new 600-ton inactive mixer has now reached a fairly advanced stage. As soon as the new mixer is operating, it is intended to convert the existing 400-ton active mixer to a 300-ton tilting furnace. The foundations for two new soaking pits at Skinningrove are progressing. The only major item in its development programme which remains to be put in hand is the large-scale extension of the 18in mill, which it is anticipated will more than double the present output capacity at Skinningrove.



WORK ON NEW BLAST FURNACE AT SKINNINGROVE

From what is contained in the foregoing review, it will be clear that the British steel industry's development programme is now well in train. Already it is proving advantageous to the national economy and it has been successfully adjusted during the last two years to meet changing assessments of the country's needs. In making these adjustments, there has been no difficulty in reaching agreement between the Government and the industry, and in organising the energetic carrying out of the necessary practical steps.

But it cannot be overlooked that the introduction of the Iron and Steel Bill raises many issues, and certainly creates several grave difficulties. The British Iron and Steel Federation has pointed out that some of the companies concerned, although not short of money at the present time, will need to enter into commitments before May 1, 1950, for sums far in excess of their present resources, and in normal circumstances would have been securing the additional capital by means of arrangements providing for the eventual issue of share capital at the appropriate time. The Bill, however, increases the difficulty of raising capital and especially of raising a substantial proportion by the issue of ordinary shares. In addition, the possible segregation of parts of companies impinges on development and new financing, but if segregation was not carried through where economically practicable, the State would become involved in developing many industries far beyond the bounds of iron and steel. Finally, the Bill imposes limits on the expansion of the smaller iron and steel firms by reason of the fact that growth to over 20,000 tons a year—a stage envisaged in a number of their development schemes—would render them liable to acquisition by the Corporation which is to be set up. These and many other problems associated with the proposed change to State ownership midway through a major development plan must inevitably raise some serious difficulties which, for the present, at any rate, would appear to be well-nigh impossible for the industry to solve.

Electrical Engineering in 1948

No. III—(*Continued from page 71, January 21st*)

MARINE engineering matters have been dealt with elsewhere in these columns so that, in the present article, we need only concern ourselves with those aspects of the subject that are likely to interest electrical engineers. Prominent among the technical developments which attracted increased attention in 1948 was the use of alternating current on ships' installations, the emphasis being on the flexibility that can be achieved with the use of transformers in a.c. distribution systems. As might be expected, the first installation of this kind was relatively small: two 1780-ton colliers, equipped throughout with a.c. auxiliaries were completed for the British Electricity Authority, Southern Division, and recently the first of these colliers, the "Pompey," was taken into service. The electrical equipment includes two 80-kW B.T.-H. alternators, driven by reciprocating steam engines. Main switchboards, with provision for shore supply, are fitted and squirrel-cage induction motors are used for the warping winch, hatch winch, windlass, steering gear, pumps and fans.

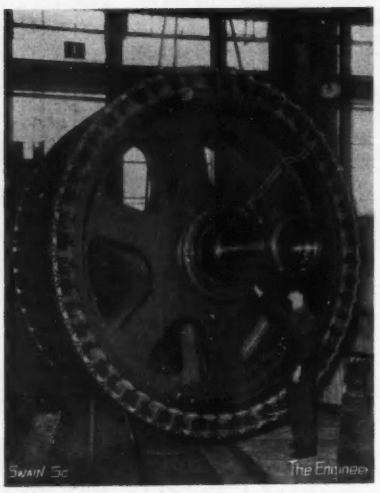
More significant, perhaps, is the news of the decision reached by the Admiralty to install alternating current, three-phase, 440-V supply systems on four destroyers, marking a radical departure from the orthodox d.c. system used hitherto on British warships. This development will be watched with a good deal of interest.

An interesting comparison can be drawn between the propulsion arrangements adopted for the 13,000 s.h.p. tanker, T.E.S. "Hyalina," and the 3750 s.h.p. motor vessel, "Auris,"—two new ships owned by the Anglo-Saxon Petroleum Company, Ltd., and operating between Curacoa and Shellhaven. The two main B.T.-H. alternators of the "Hyalina" are "mechanically paralleled" by virtue of the fact that each set supplies one of two electrically separate motors, mounted in a common frame and driving on to the propeller shaft. This arrangement combines the advantage of efficient single-screw propulsion, with the choice of two economical speeds, depending upon whether one or both of the turbo-alternators are in service. The "Auris," on the other hand, makes use of a different arrangement, but offers similar advantages. Four 830-kVA diesel-driven alternators are held in step by the B.T.-H. double-unit arrangement, their outputs being paralleled up to the main busbars feeding the single unit propeller motor.

Direct-current diesel-electric equipment, operating on the constant current series system, will provide the new propulsion system on the "Barrenjoey," a double-ended ferry owned by the Port Jackson and Manly Steamship Company, Ltd., and operating in Sydney harbour. Power for the B.T.-H. electrical equipment is provided by four 320-kW diesel-driven generators. The propeller motor at each end of the vessel is driven by two 615 h.p. motors through 790/158 r.p.m. reduction gearing. Current in the main power circuit is held constant at 1000A by amplidyne control. Adjustment of propeller motor field strength determines the speed, and matters are so arranged that, while the aft propeller provides power, the forward propeller turns at zero thrust. Complete control is provided at the bridge.

Controlled constant current is also used for propulsion and for dredging in the three diesel-electric dredgers ordered by the Mersey Docks and Harbour Board. The first of these dredgers, "Mersey No. 26," was handed over to the owners towards the end of 1948. Double-armature 840 h.p., 135 r.p.m. motors, supplied by three 450-kW generators, drive the two propellers. The deck machinery includes three dredges, each requiring a maximum of 80 h.p. All the electrical equipment was supplied by the Metropolitan-Vickers Electrical Company, Ltd.

The photograph reproduced herewith shows the salient-pole rotor of a 9000 s.h.p. propulsion motor installed in a single-screw oil tanker, owned and operated by the Eagle Oil and Shipping Company, Ltd. A 6930-kW



MAGNET WHEEL OF 9000 S.H.P. PROPULSION MOTOR

turbo-alternator supplies the motor and the complete electrical equipment was manufactured by the General Electric Company, Ltd., which is engaged on a repeat order for two other similar installations.

Motors for Mines

British manufacturers of electrical equipment for mines were fully occupied during 1948, producing a wide variety of plant, ranging from transformers and switchgear to motors of all sizes for use above and below ground. Here there is only sufficient space to touch briefly upon a few of the more spectacular activities.

A new system of dynamic braking for winder equipments was introduced by the British Thomson-Houston Company, Ltd., making use of a device known as the volts-per-cycle regulator. This braking system embodies a simplified control scheme and provides compensation of the d.c. excitation so that it increases as the winder speed increases. This provision eliminates the objectionable loss of torque due to armature reaction, which is normally associated with the induction motor under dynamic braking conditions. With the new system, therefore, the driver cannot lose braking torque through moving the lever too fast. Five winder equipments embodying these improved braking arrangements are being manufactured for South Africa, for installation underground. Three of the winders are 995 h.p. equipments and the other two equipments are rated at 2370 h.p.

What is believed to be the longest semi-automatic skip hoist in the world was ordered in 1948 from the English Electric Company, Ltd., for service at a copper mine in Northern Rhodesia. This hoist will have a rating of 3636/7000 h.p. and will raise a load of 23,600 lb at a speed of 2500ft per minute from a depth of 1950ft. Twin d.c. motors, operating on the Ward Leonard-Ilgner system, will supply the drive to a common pinion and, through gearing, to a double drum, each drum being clutched. "Magna-volt" control will be used, and in addition to the usual mechanical braking on the flywheel set, d.c. dynamic braking of the a.c. motor will be incorporated.

The electrical equipment for what will be the largest walking dragline to be built in this country is of some technical interest. The dragline, which will weigh 1500 tons complete and will have a boom 282ft long and a bucket capacity of 20 yards, will be driven by amplidyne controlled Ward-Leonard equipment, providing a nominal power of 900 h.p. for each of the hoist, drag and walk motions, and 450 h.p. for the swing motion. Both of the 1200-kVA synchronous motors driving the main motor generator sets will be maintained by a single amplidyne at unity power factor under all load conditions. The dragline is being built by Ransomes and Rapier, Ltd., for Stewarts and Lloyds, Ltd., for use at Corby and the electrical equipment is being supplied by the British Thomson-Houston Company, Ltd.

Some Rolling Mill Drives

Activity in the provision of electrical equipment for rolling mill drives was well maintained in 1948, when a number of plants were put into operation. Prominent among them was the large tube mill of Stewarts and Lloyds, Ltd., at Clydesdale, Glasgow, where large seamless tubes up to 16in diameter are now being produced. This plant consists of two mills, the first, or elongator mill, being driven by a B.T.-H. 1700 h.p., 70/125 r.p.m., d.c. motor. The second, or Pilger mill, is driven by a B.T.-H. 2200 h.p., 32/65 r.p.m. d.c. motor. Both motors take their supply from a synchronous motor generator set.

Of the reversing mill plants put into service in British steelworks, mention should be made of two Metropolitan-Vickers equipments—a 32/34in section mill at Scunthorpe and a 40in cogging mill at Middlesbrough. The main mill motors are 5000 h.p., 50 r.p.m., d.c. machines, the one at Scunthorpe being supplied from a 4500-kW motor generator set with a 17,500 h.p.-second flywheel and three generators in tandem.

Motors for Industry

Turning to the manufacture of motors for industrial drives generally, we find that a number of British manufacturers reported an improvement in production during 1948, due partly to an easing in the supply of materials and partly to extensions of manufacturing facilities. For example, we learn from the Metropolitan-Vickers Electrical Company, Ltd., that the manufacture of motors at the Mosley Road works was fully consolidated, the output having been increased to about twice the pre-war volume. One of the technical developments contributing towards this improvement is the installation of a centrifugal casting plant, mainly to deal with certain sizes of motors, the production of which was transferred from the A.E.C. Birmingham works. New vacuum

impregnation plant for stators is now being erected in the dip shop, and will greatly increase the capacity of the existing equipment and contribute to a useful reduction in manufacturing time.

In the smaller motors there was continued evidence of the trend towards the use of non-ferrous frames and end shields in an effort to mitigate the effects of the shortage of ferrous castings. This change was standardised by the Metropolitan-Vickers Electrical Company, Ltd., on a number of frame sizes. A similar change of practice was effected by the British Thomson-Houston Company in the production of fractional horsepower motors, the end shields of which are now made almost exclusively of pressure-die-cast aluminium.

Arrangements were completed during 1948 for the development and manufacture of the new range of English Electric a.c. and d.c. fractional horsepower motors, which are now in full production.

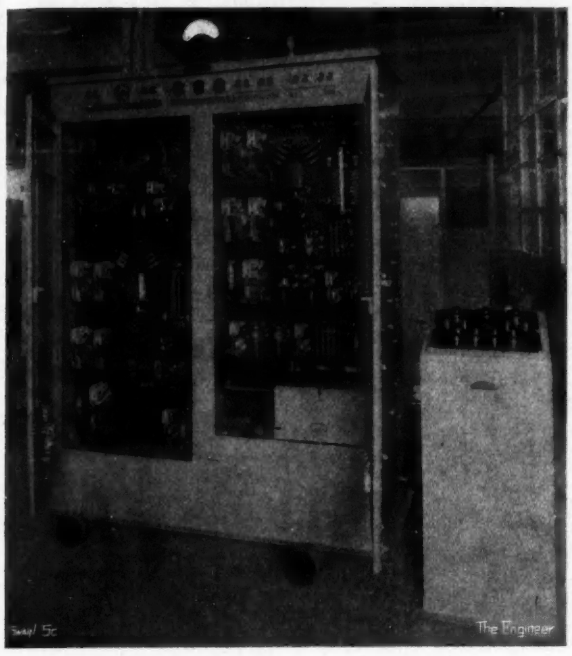
Machine Tool Drives

Present-day trends in the design of motor-control equipment for machine tools were well exemplified at the recent Machine Tool and Engineering Exhibition in London, where visitors were able to examine numerous examples of built-in control gear as well as apparatus designed for separate mounting. In addition to the orthodox single-speed and multi-speed, fixed-ratio drives, a number of machine tools were exhibited driven by variable-speed motors, with electronic control.

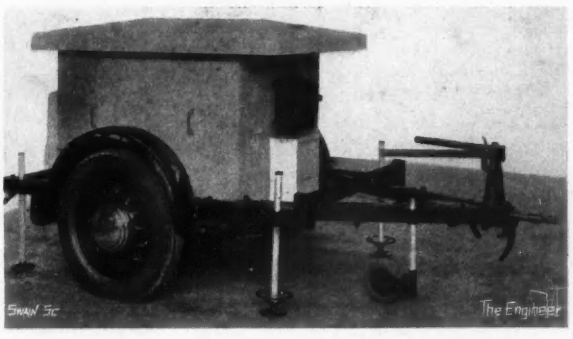
Considerable interest was aroused by the first British automatic contouring equipment which was introduced by the Metropolitan-Vickers Electrical Company, Ltd. A number of equipments of this kind have been supplied in association with tools such as a 32in swing-centre lathe, a 56in diameter vertical boring mill for wheel-turning and a heavy duty vertical milling machine for glass moulds. In all of these applications the motion of the cutting tool or work is controlled in two directions, mutually at right angles, with the result that complex shapes, with re-entrant portions, can be reproduced more quickly than by other methods. The electronic control of the motor is actuated by an electro-magnetic tracer head, in contact with a template.

One of the photographs reproduced herewith illustrates a multi-motor panel and one of four control stations, specially designed by Brookhirst Switchgear, Ltd., for what is probably the largest gear-hobbing machine in the world. Details of this machine are not yet available but it is believed that it will cut pinions up to 2m dia.

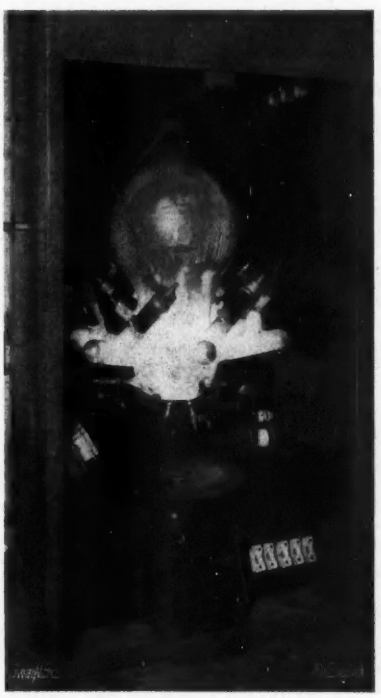
The control equipment is centralised in a single cubicle provided with a common isolating switch. Control of the six 220/440-V d.c. motors is effected from four separate control stations—a main station being situated on each side of the machine and two subsidiary stations being mounted on the machine saddle. In our illustration one of the main control stations is shown on the right of the central cubicle. The main control stations give control of the hob spindle, longitudinal traverse, lubrication pump and coolant pump drives, while the control stations on the machine saddle give control of the cross traverse and longitudinal traverse drives. The dividing head drive is operated by limit switches, actuated from a mechanical positioning device. By the use of push-button control the hob spindle and longitudinal traverse motors can be started and inched, forward and reverse, and the speeds can be varied.



CONTROL EQUIPMENT FOR LARGE GEAR HOBBER



RECTIFIER STARTER TRUCK FOR GAS TURBINE ENGINES



MERCURY ARC RECTIFIER FEEDING POWER STATION AUXILIARIES

Rectifiers

An interesting advance in mercury arc rectifier design was the introduction by the General Electric Company, Ltd., of rectifiers with additional anodes for supplying the fields of d.c. motors. A single grid-controlled rectifier incorporating this device can operate as a complete unit for a variable-speed d.c. drive in which the motor armature is supplied with a smoothly variable d.c. voltage from the main grid-controlled anodes while the motor field is supplied from the field anodes. Units of this kind are being supplied for rolling mill drives and similar applications for which they are particularly well suited.

At Rugby the new B.T.-H. rectifier factory began full production, during 1948, of the company's new ranges of pumpless steel tank rectifiers and of glass bulb units. A number of detailed technical advances are embodied in these equipments as described in *B.T.-H. Activities*, No. 11, Vol. 19, May/June, 1948.

Two novel applications of rectifiers deserve mention here. Grid-controlled rectifiers were used for the first time to feed the variable-speed motors used in unified boiler control equipment in power stations. Two such Metropolitan-Vickers installations were put in commission during 1948—the first at Trafford power station (Stretford) and the second at Nottingham, where this system of control was applied for the first time to pulverised fuel fired boilers. The Trafford installation consists of two 414-kW, 0–500-V glass bulb fan-cooled, mercury arc rectifier equipments, one of which is illustrated herewith. Similar equipments are now on order for B.E.A. power stations at Portsmouth, Doncaster, Thornhill and Stuart Street, Manchester, and also for I.C.I. (Metals), Ltd.

The second application involves rectifiers as applied to a starter truck for gas turbines. The equipment, illustrated herewith, was manufactured to provide a d.c. output from a.c. mains supply for starting aircraft gas turbine engines. Essentially the electrical apparatus consists of a three-phase, double-wound transformer and a three-phase bridge connected selenium rectifier mounted in a weatherproof cubicle on a mobile trailer. The equipment is suitable for use with a

400-440-V, three-phase, 50 c/s supply, and is capable of giving a nominal output of 1200A intermittently at 24V.

This design of starter has proved useful on aerodromes where it is necessary to start a number of gas turbines in fairly rapid succession, for the starter motor fitted to these turbines has such a high consumption that only a very few successive starts can be made with the battery truck normally used. An advantage of the rectifier starter therefore, is that each successive start is made under exactly the same conditions, whereas when a battery is used this may not be so, since the battery is being steadily discharged.

Similar equipments, one in a static form, have also been produced for test bed use. The equipment illustrated was supplied by Standard Telephones and Cables, Ltd., to the Gloster Aircraft Company for starting Rolls-Royce "Nene" and "Derwent" gas turbines.

(To be continued)

Catalagzi Power Scheme, Turkey

THE formal inauguration took place on November 27, 1948, of the new regional power station on the site known as "Direk Harmani" at Catalagzi, on the shore of the Black Sea, near Zonguldak, Turkey. This power station supplies electrical energy to the mines in the Zonguldak coal region and to the city and port of Zonguldak; in the future it will also supply the projected coaling port which is to be built either at Catalagzi or in Eregli. Eventually the railway which is to join the new coaling port to Karabuk is to be electrified, and the electrical energy required to do this will also be supplied by the power station at Catalagzi. The original contract for the power station, three sub-stations and transmission line was placed in 1939 with the Metropolitan-Vickers Electrical Company, Ltd., by the Turkish organisation known as the Eti Bank.

The power station was declared open by Mr. Hasan Saka, the Turkish Prime Minister. He was accompanied by Sir David Kelly, the British Ambassador; Mr. Muntz, the British Commercial Attaché; and many high officials of the Turkish Parliament. The visiting party came from Ankara by special train and were conducted on their tour by the site director, Mr. Salim Oker.

The Power Station

A photograph showing the power station building is reproduced herewith. The lay-out of the present power station building is based on modern British practice for stations of this size, and includes a chemical laboratory and considerable office accommodation.

The present capacity of the station is 60,000kW in three units of 20,000kW, and this will be doubled in the future. Coal for the power station is obtained from the coal regions of Zonguldak and is brought to the site by special cars of 60 tons capacity. Normally the coal is fed through the coal-handling and pulverising plant directly from the railway to the furnaces. For diverting coal to the storage space and subsequent reclaiming a drag scraper installation is provided.

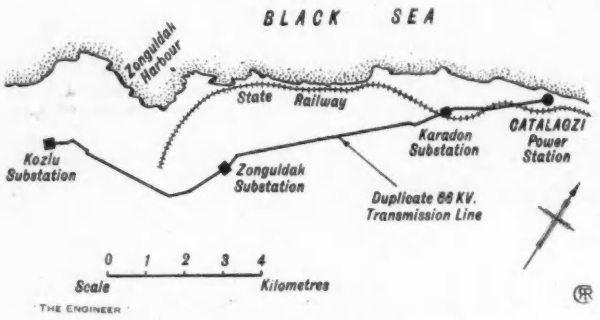
Ash from the hoppers beneath the boilers and dust from the grit arrester is sluiced to the ash sump between two of the boilers. From there it is pumped into ash dumps on the river bank.

The present installation has three boilers, one of which is spare. They are each capable of supplying 220,000 lb of steam per hour at 595 lb per square inch and 840 deg. Fah. For normal duty they are coal fired, but they are arranged for oil firing for light loads up to 20 tons of steam per hour.

One of the accompanying photographs shows a general view of the turbine room, which houses three turbo-alternators, each of 20,000kW, C.M.R. (16,000kW economic rating). Each turbine has three-stage feed heating and gland heating, with an ejector, drain coolers and unit evaporators, exhausting at 28·9in vacuum.

Cooling water requirements for the condensers, air and oil coolers, and other auxiliary services amount to 14,000 gallons per minute. This is drawn from a lagoon which has been formed on the shore of the Black Sea by building a breakwater about 750ft long to form a settling pond, so that in stormy weather there will be time for sand to settle before the water enters the intake works. The construction of the breakwater was facilitated by the fact that the Black Sea is not tidal and has only a small variation in level throughout the year. The surface area of the lagoon is 108,000 square feet, or approximately 2·5 acres, and the total quantity of water enclosed is 3,500,000 gallons.

The cooling water enters a concrete intake tower in the middle of the lagoon and is fed by gravity through tunnels 300ft long, bored through the rock below sea level, to the pump-house on the shore, which contains settling and screening chambers and a pump suction chamber. There is provision for chlorinating the water for the removal of mussels in the intake tunnels. There are three vertically driven circulating water pumps which can each operate separately. They pump the water through a pipe-line, 1800ft long, to the condensers, which are in the turbine room basement. The water is then led through a pipe main, 1270ft long, to a catchpit, and thence by an open concrete channel to the sea. The total distance from the pump-house to the sea via the condensers is approximately 4750ft.

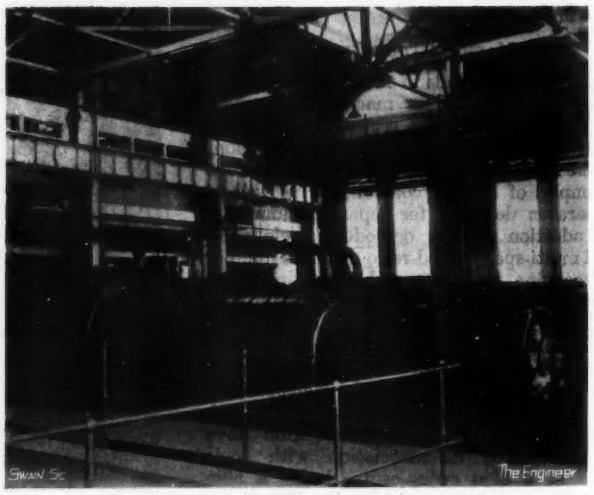


PLAN OF CATALAGZI POWER SCHEME

Each turbine drives a 20,000-kW main alternator generating current at 11kV, which is transformed to 66kV for transmission, each generator being connected directly to its transformer without intermediate switchgear. Each turbo-generator set also includes a 1500-kW house alternator generating at 3kV. Since the station has no access to external electrical power, a 500-kW diesel-driven alternator set is provided for starting up the necessary auxiliary motors from a dead station.

The main transformers are cooled naturally without the use of water and are situated outside the station in a transformer court. To level the site for this and the switch yard part of the hillside behind the station had to be cut away. The switch yard contains seven air-blast switches of 750MVA rupturing capacity, which are served by a duplicated air compressor plant. There are three main groups of 3-kV oil switchgear for the station auxiliaries, the

CATALAGZI POWER STATION



TURBINE ROOM, CATALAGZI POWER STATION

switches in the groups being arranged back to back to form a duplicate bus system.

Sub-Stations

As shown in the accompanying map, the three principal sub-stations are named Karadon, Zonguldak and Kozlu, and the main transmission line from Catalagzi passes through them in that order. The three-phase, double-circuit transmission line is about 9·5 miles long and the earth cables are carried on the same supports as the six conductors comprising the two circuits. The general route of the transmission line is in a westerly direction from the power station, passing through thickly wooded territory.

At the sub-stations the incoming power is transformed from 66kV down to 15kV for transmission to local collieries, the transformers being rated at 12,800kVA. At each sub-station there are three 66-kV air-blast switches for the incoming supply, as well as a number of 15-kV metal-clad switches, which feed directly to the local networks. The air-blast switchgear and the step-down transformers are out of doors, and the rest of the equipment (including duplicate air compressor plant for the air-blast switches) is housed in a small one-storey building. There are also residential quarters for the operating staff.

The main contractor for the scheme was the Metropolitan-Vickers Electrical Company, Ltd., and the principal sub-contractors included Babcock and Wilcox, Ltd., for the boiler and coal-handling plant; Holloway Brothers (London), Ltd., for all buildings and civil engineering work, including the cooling water intake; British Insulated Callender's Cables, Ltd., for the overhead transmission line and all the cabling of the project. The principal parts of the plant in the power station and the sub-stations are protected against fire by the Mather and Platt "Mulsifyre" system.

We learn that the scheme is now nearing completion; two turbo-generator sets are in commission and the third, which has already been on load, will be in commission very shortly.

The Decca Navigator System with Lane Identification

ON Wednesday, January 19th, at 12.00 G.M.T., the Minister of Transport, Mr. Alfred Barnes, closed a switch at the master station of the Decca Navigator Company, Ltd., at Puckeridge, Herts, which for the first time brought into operation the company's new lane identification transmission service. This service enables all ocean-going ships to use to the full the Decca electronic navigational aid, already employed with satisfaction in most of the coastal vessels sailing in British waters and in the North Sea between England and Denmark.

A large company of guests, representing various aspects of marine navigation were present at the ceremony, and the Minister was warmly welcomed by Mr. E. R. Lewis, the chairman of the Decca Company. In his speech, Mr. Lewis paid a warm tribute to the work which had been done by his technical director, Mr. W. J. O'Brien, and Mr. H. F. Schwarz, the vice-chairman of the company, in finding a successful solution of the lane identification problem, which, he said, will extend the Decca principle of navigation to wider areas and to other ships.

Group Captain E. Fennessy, B.Sc., another director, then gave a short description of the working principle of the system, and explained its value as an aid to ship navigation.

Mr. Alfred Barnes said that his Ministry was interested in any scientific device which gave aid to mariners and increased the safety of life at sea. He spoke of the success of the English and Danish Decca chains, which covered an area of 500,000 square miles, and the two other chains, in Scotland and in Western England, which had already received the Ministry's sanction and upon which work had begun.

Lane identification, he continued, marked a great step forward, and as a result of that development he felt that the system would be used to equip many more ships. The two largest liners, the "Queen Mary" and the "Queen Elizabeth," were already fitted with Decca navigation, and more than 600 coastal and smaller ships were equipped with the system, which had also been adopted internationally.

The system, Mr. Barnes went on to say, did not supply the complete answer to safe navigation in fog, for in addition to the Decca position-fixing system some form of radar apparatus was, he thought, necessary. The great advantage of the Decca system was that it gave a correct fixing of position at any time, and in the event of fog it would enable a ship to proceed where in the same circumstances good seamanship would require anchorage because of the uncertainty of position. He pointed out that during one year some 30 million tons of goods were carried by our coastal ships, and in that period there were from 400 to 1000 hours of fog, equivalent to one or two hours each day. The fitting of Decca navigation and radar equipment had done much for our coasting trade, and voyages were now made with greater regularity. He congratulated the company on its British lead in navigational aid, and looked forward to the extension of the system to deep sea ships and ocean-going liners as well as aircraft.

Development Work

The Decca Company was brought into being at the end of the war to undertake the development of its system as an aid for merchant shipping and civil aviation, with the authority of the Admiralty and the Ministry of Transport. At the beginning of 1946 construction was begun on the English chain which came into operation during the summer of the same year. In January, 1947, following tests by the Ministry of Transport, a notice was issued to mariners approving the system. In the spring of that year it was approved by the second International Meeting on Marine Aids to Navigation held in New York.

Following an agreement between the company and the Royal Danish Navy, the construction of the Danish chain of stations was begun and was opened in October, 1948. These two chains cover half a million square miles, extending from the Atlantic Ocean to the Baltic Sea.

In addition to its increasing use by ships, Trinity House, we understand, finds it of great value in the important work of maintaining the position of lightships and buoys around the coasts of Great Britain. The General Post Office utilises it in its cable-laying operations, while the salvage companies find it a great aid in the location of wrecks. The Decca system is also being widely used by several Governments for hydrographic and aerial survey work. British and French air services are using it for cross-Channel civil aviation purposes, and its use will be greatly increased, it is expected, now that lane identification has been solved.

Future Developments

With the introduction of lane identification and with the English and the Danish chains now in service, the main work connected with the completion of the European system is practically completed. In order to give greater accuracy along the West Coast of England and around the Scottish coast, the Ministry of Transport has asked the Decca Navigation Company to construct two further chains, and work is now being begun on these projects. Now that the successful results of the system are becoming known throughout the world, there are a number of important projects under discussion for the expansion of the system in the Dominions and in other parts of the world.

Basic Principles of Operation

The Decca system is a means by which the navigator of a ship or an aircraft equipped with the necessary receiving apparatus can, by reading two decometers, and plotting their readings on specially latticed charts, fix his position with a very high degree of accuracy up to considerable distances from the transmitting stations. These transmitting stations, known as a Decca chain, comprise a master station and three slave stations. The master station transmits a radio signal, which is instantly repeated by the slave stations, and thus forms a hyperbolic pattern of lines of constant path difference in space, forming radio lines of position. It is these lines of position which drive the meters on the ship or aircraft receiver, known as "decometers." Special Admiralty charts overprinted with the Decca red, green and purple lattices are available from Admiralty chart agents.

325FT. TRANSMITTING TOWER

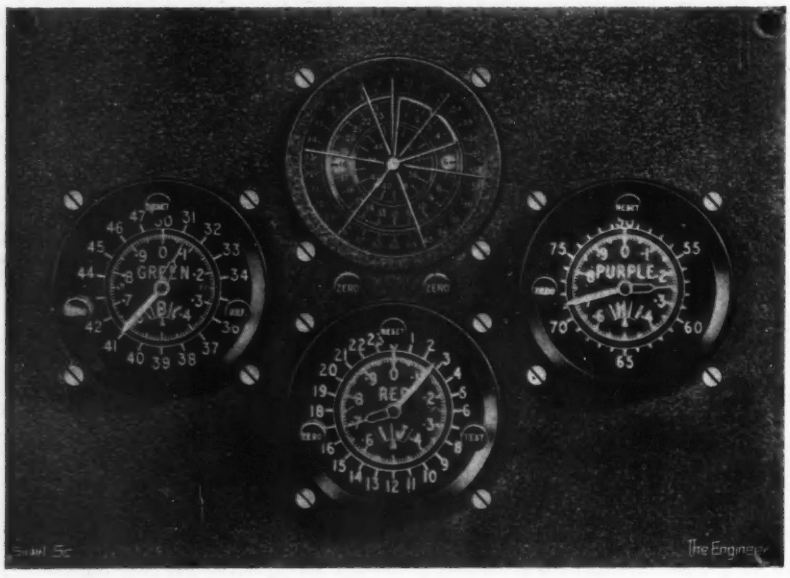
In the British chain, the master station is at Puckeridge, in Herts. The main transmitting mast is shown in the accompanying engraving. It has a height of 325ft and is built of galvanised steel lattice work with four arms and a specially designed aerial system. The power supply is safeguarded by having available the public supply mains, with two diesel-engine-driven generators and a petrol-electric generator, all such sources being linked by automatic switches to maintain a continuous transmission without apparent interruption. The apparatus includes transmitting units and tank coil units. A twenty-four-hour service is given at each station. The slave stations are generally similar in design as regards the transmitting mast and equipment, but there is also a mast which receives the signals from the master station to which the slave transmission is locked. In all stations there are three identical transmitters linked by fast-acting automatic mechanism, and similar control mechanism to ensure constant transmission.

The three slave stations are situated at East Hoathly, near Lewes, Sussex, at Wormleighton

in Warwickshire, and at Shotesham, near Norwich, Norfolk.

The Lane Identification System

Before lane identification was introduced at mid-day on Wednesday, January 19th, ships found it difficult when first entering the area of coverage to use the navigator system, as some reference point was necessary before the refer—either red, green, or purple. Identification takes place at about one minute intervals, and when the identification transmission occurs the appropriate scale of the meter lights up and the main pointer swings to the correct position on the scale. It will also be seen that there are six light pointers on the meter, which are fixed to a common shaft, and during an identification transmission these serve as a vernier indication. The verniers are particularly useful



Lane Identification Meter with Decometers

decometers could be set and the equipment brought into use.

The system of lane identification adopted is equivalent to superimposing a coarse pattern on the normal Decca fine pattern. Our illustration shows the new instrument board for installation in a ship or aircraft. There are, it will be noted, three decometers recording the readings of the red slave, the green slave and the purple slave stations at the bottom, left and right respectively. Each of these instruments is complete with its zero, reset and test knobs. Above them is the lane identification meter, which, it will be seen, has three scales engraved upon Perspex rings, which are individually illuminated in the colour corresponding to the meter or pattern to which they at night, especially when beyond 100 miles from the transmitting station. Under such conditions the correct lane reading is that indicated by the fine pointer nearest the main pointer. During daylight working the pointers may be disregarded, as one will always line up with the main pointer.

From what has been said it will be appreciated that the identification is completely automatic, and that it requires no operation on the part of the user, except to read off the correct lane number when the meter is illuminated. From that reading the reference point is established by a ship entering the transmission area, and the Decca navigational equipment can be immediately brought into use by setting up the decometers.

Wiped Joints for Aluminium Sheathed Cables

An important stage in the development of aluminium-sheathed cables by Johnson and Phillips, Ltd., Charlton, London, S.E.7, was reached recently when the company succeeded in devising a simple technique for producing wiped joints. Last week we witnessed a demonstration at the company's Charlton works which showed that wiped joints can be made on aluminium-sheathed cables using a method substantially similar to the familiar lead wiping process.

It may be recalled that the aluminium-sheathed cable was fully described in our issues dated April 23 and 30, 1948, where reference was made to such properties as lightness and mechanical strength which make aluminium an attractive material for cable sheathing. To recapitulate very briefly, the cable itself is of orthodox design and construction conforming to British Standards in every respect, except that the cable sheath consists of a continuous, seamless, close-fitting tube of commercially pure aluminium (99·6 per cent Al, minimum content) instead of lead.

After the manufacturing process had been perfected, one of the major difficulties confronting the company was the problem of jointing. Naturally, the so-called compound sealed joint could be used as readily with aluminium-sheathed as with lead-sheathed cable, but for the sleeve type joint some kind of easily constructed seal was essential. The obvious method was to use a wiping process. However, at the time when the cable was first introduced, no simple technique had been evolved for making reliable wiped joints on aluminium sheathing, although the company had made some progress towards solving the outstanding problems. Initially, therefore, while research on wiped joints was proceeding, a mechanically sealed joint was devised (as described, *loc. cit*). Although this form of mechanical union makes a reliable joint, it is unlikely to be generally used in quantity now that the simpler and cheaper wiping process has been developed.

Wiped Joints

Some eight months after the original announcement of the aluminium-sheathed cable, Johnson and Phillips, Ltd., succeeded, with the help of the British Aluminium Company, in devising the method of wiping which is described below. Apart from the second stage of the process—tinning the aluminium with a special solder—the procedure is very much the same as in lead wiping, and, although allowance must be made for the different properties of the unfamiliar metal, an experienced jointer can readily attain proficiency after a little practice.

Ordinary plumbing metal of good quality is used to make the joint, and the solder recommended for the tinning, as described below, can easily be made up or supplied on request. For sealing the cables into terminating boxes the ordinary brass wiping gland is used, and, for joints, standard lead or copper sleeves are suitable. Lead caps are invariably used for sealing the cable ends, and the button or disc seal is not recommended for this purpose.

The wiping process consists of three distinct operations—cleaning, tinning and wiping. In the first place, it is essential to remove all traces of grease or oil from the sheath, after which the surface oxide film must be removed by uniform, but not deep, scraping with a fine file or wire brush. This scraping should obliterate any longitudinal scratches or marks that may be present on the sheath, and care should be taken to prepare the entire surface as evenly as possible for tinning.

No flux of any kind is used in the tinning process and the solder is an alloy, consisting of 90 per cent tin and 10 per cent zinc, which is supplied in stick form.

The cleaned surface of the sheath is heated by means of a blow-lamp to a temperature sufficient to melt the solder, and the latter is then applied by rubbing the stick firmly and evenly over the heated surface. Rubbing assists removal of the thin layer of oxide which immediately forms after cleaning, and should

Wiped Tee Joint

leave the solder deposited fairly evenly over the surface of the aluminium. Tinning is completed by methodical application of a wire brush to the aluminium through the molten layer of tin, so removing any remaining oxide and promoting thorough amalgamation with the aluminium. The efficacy of the process can be tested by applying a cloth to the tinned surface while the metal is molten ; this should leave a bright smooth finish.

For the final operation of wiping the sleeve to the tinned sheath only standard quality (Grade D) plumber's metal is used, and it is

applied in stick form. Pot wipes are not satisfactory owing to the presence of zinc in the tinning metal. Normal wiping procedure is followed, but care should be taken to use only a trace of tallow and not to allow the tallow to touch the tinned aluminium. The wipe should be completed cleanly with the minimum of brushing, avoiding excessive application of heat.

Unless enclosed in a compound filled box the wipe and adjacent 2in of cable sheath should be painted with bitumastic paint or similar protective coating after the joint has cooled. A typical wiped tee joint is illustrated herewith.

We are informed that wiped joints of the kind described have been subjected to a number of tests in the makers' works and elsewhere. The tests involved the application of mechanical stresses in various ways—for example, by internal pressure, longitudinal tension and vibration—and the resistance to corrosion as determined by exposure to salt spray.

A number of test specimens were on view in the jointing room where the wiping process was demonstrated. In one particular test rig two lengths of cable with straight-through joints were arranged to be vibrated transversely at 500 cycles per minute while the sheaths were heated electrically to 70 deg. to 80 deg. Cent. and subjected to internal pressure ranging between 20 lb and 25 lb per square inch. With this arrangement more than fifteen twenty-four-hour heat cycles have been carried out without any sign of distress.

Bonding and Earth Clamps

It is stated that the bonding of the cables can be carried out satisfactorily by using cadmium-coated copper or, alternatively, aluminium strip bolted to the sheath in the normal manner. The former is preferable since it eliminates any difficulty associated with the junction of the bonding strip and plain copper earthing strip under damp conditions.

The recommended procedure in applying a bond is first to smear petroleum jelly on the contact surface and then to burnish over the jelly with fine emery paper, following which the connection is applied and pulled tight. The strength of the aluminium sheath enables the fitting to be tightened well down without causing damage to the cable.

Power Station Fuel Ash and Land Reclamation

With the increasing use of pulverised fuel in modern power stations the problem of ash disposal is assuming considerable proportions. So far it has not been possible to find economic commercial or industrial uses for more than a comparatively small proportion of the 750,000 tons of ash produced annually at the power stations of the British Electricity Authority. In several instances, however, ash has proved to be suitable as a filling material for raising the level of low-lying land, and experiments have shown that such land can be restored to agricultural uses if the ash is allowed a reasonable period for settlement and covered with soil of sufficient thickness and suitably fertilised.

An interesting scheme of this kind has recently been carried out in collaboration with local officials of the Ministry of Agriculture on land adjoining the Hams Hall generating station, near Birmingham, where some 4¼ acres have been successfully reclaimed and used for cattle grazing. Ash had been deposited on the site to an average depth of 8ft. At the beginning of the experiment a 2in layer of soil was spread over the top and treated with 10 tons of ground carbonate of lime, 1 ton of superphosphate (18 per cent soluble phosphor acid), 5 cwt of sulphate of ammonia (20 per cent nitrogen), and 5 cwt of muriate of potash (60 per cent potash).

During May, 1948, the tenant farmer sowed 60 lb of cockfoot S.143, 30 lb of red fescue S.59, 15 lb of white clover S.100, and 20 lb of Italian ryegrass, and by the end of September the land was in use for grazing. No ill-effects upon the cattle have been observed. The approximate cost per acre was £80, calculated as £14 for fertilisation, seeding and cultivation, £45 for soil spreading and transport, and £21 for fencing and incidental works.

Light Alloy Rolling Stock for London Transport

Orders have been placed by the London Transport Executive for ninety surface line motor-cars of the latest "R" type at a cost of about £1,250,000. These cars are to have structures fabricated from aluminium alloy sheets and sections, and it is believed that this is the first large production order for railway carriages in aluminium alloy to be placed in this country. Besides effecting a useful economy in the demand for steel, a number of technical advantages are expected from the use of the new material.

Two complete eight-car trains to be formed from these light alloy cars will be operated as units to obtain performance data. The remainder of the cars will be operated in service interchangeably with existing steel cars in order to obtain experience of the relative maintenance costs of the two types. Superficially both the aluminium alloy and the steel cars will be identical in appearance, the same general design having been followed.

The placing of the order was the culmination of a long and careful investigation into the relative merits of mild steel, high tensile aluminium alloys and rustless steel for the construction of car bodies used in intensive urban electric services. Weight, cost and developments in car construction in other countries were studied and, as a result, the use of an aluminium magnesium silicon heat-treated alloy was decided upon.

It is estimated that the saving in weight per car by the use of this light alloy will be about 3·1 tons for a car with the same structural rigidity as the existing steel cars. In selecting the particular alloy the aspects of corrosion and fatigue were investigated, and it was considered that a life at least equal to that obtained from steel cars would be achieved provided hydrochloric acid washing processes are not used.

Existing steel cars were designed with the skin or outer plating and the structure or framework sharing the load, a combination that is akin to the stressed skin design of aircraft. The same basis will be followed with the light alloy, but advantage will be taken of the fact that it is possible to extrude shapes in aluminium alloy which could not be obtained with the rolling technique applied to steel and thereby to permit a better disposition of available material to take the stresses imposed on it.

The resistance of this alloy to abnormal buffing stresses has been examined by experiments which showed that, when used in a manner comparable with mild steel, it absorbed within the elastic range a greater shock than steel.

When the new cars are in service, in about two years' time, the reduction in weight will be reflected immediately in reduced current consumption, the control equipment being so arranged that the operation of the contactors will produce the same curves of acceleration as for steel cars. The balancing speeds will also be the same. Motors and electrical equipment will be of the usual standards, and the bogie trucks will be built of steel, at least for the present batch of cars, and pending further development work.

The short-term value of the current saving must be calculated on the basis of the marginal cost of current at the train, i.e., the cost of generation and distribution. Even on this basis the extra capital cost of these aluminium alloy cars over steel cars is expected to be more than offset by the saving in current costs, assuming, as is expected, that the life and the maintenance costs are the same for the alloy cars as for steel cars. In the longer term, the general adoption of the lighter form of construction should enable savings to be made in generating and distribution plant capacity.

The London Transport Executive states that its policy is to replace the older stock, consisting of a mixture of motor and trailer coaches, by trains in which every car is a driven car, every other axle on the train being a motor axle, i.e., one on each bogie. By offsetting the bogie centre towards the driving axle, more than 50 per cent of the total adhesive weight will be driven. This arrangement will permit higher acceleration and an increased frequency of service on busy lines. It will reduce the total current consumption, but involve a higher maximum demand for current, which, however, the lighter construction of the new cars will counteract by reducing the demand for additional generating and sub-station capacity.

The future policy and technique regarding the use of aluminium for car construction will rest partly on the lessons learned from the behaviour of the new cars in service and partly on relative steel and aluminium prices. Confidence is expressed that the prospects of the aluminium alloy car are such as to justify the present project which, it is hoped, will provide valuable experience in the use of aluminium alloys for rolling stock.

The main contractors for the new cars will be the Metropolitan-Cammell Carriage and Wagon Company, Ltd., of Saltley, Birmingham, and the company will collaborate with the Imperial Chemical Industries, Ltd., Metals Division, Witton, Birmingham, the two firms having already co-operated in the investigation and development work leading to the preparation of the new designs.

The Anglo-American Productivity Council

The United Kingdom section of the Anglo-American Productivity Council has announced this week plans for visits of British productivity teams to the U.S.A. to study factory administration, organisation, lay-out methods and operating conditions. It is anticipated that up to April, 1950, about fifty such teams will visit America, and in the following year a considerably larger number. The teams are to be formed on an industry basis, and none will consist wholly of representatives of a single firm, the primary object being to enable the widest possible cross-section of each industry to benefit from the observations made. While no standard composition of team is to be laid down, the general intention is that each team should not exceed fifteen people in all. This arrangement envisages four representatives from supervisory levels, four or more technicians drawn from those specialising in planning, lay-out methods, work handling, personnel and costing, and four from workshop levels drawn normally from operatives and shop stewards. Each team is to be accompanied by a secretary, whose primary responsibility will be to assist in recording observations and views, so that the greatest benefit may be obtained by the industry concerned. The total commitment in time of anyone accepting membership of a team is put at about three and a half months, which will allow two weeks for preparation, two weeks for travel, six weeks in the U.S.A., and four weeks explaining and discussing his findings. The programme in the U.S.A. will be adapted to each team, but it is intended that in each case three American plants shall be studied. Employers' organisations are being invited, in co-operation with appropriate trade union officials, to nominate suitable teams. Firms whose men are selected for inclusion in a team will, it is hoped, gain by their widened experience and will be expected to pay the normal salaries or earnings during the time involved. The Government is to make a grant in aid to the British section of the Council of approximately 50 per cent of the sterling costs. The entire scheme will be directed by a Visits Committee appointed by the Council, the British section of which has offices at 21, Tothill Street, London, S.W.1. The Council has also announced this week the appointment of Mr. Kenneth J. Burton, of the British Employers' Confederation, as joint secretary of the United Kingdom section, with Sir Norman Kipping (F.B.I.) and Mr. Vincent Tewson (T.U.C.).

Metallurgical Topics

Fretting Corrosion

FRETTING corrosion is the term applied to the particular type of corrosion which occurs at the area of contact, under load, of two metal surfaces which are subject to oscillatory or vibratory motion; for example, to the slight slipping between two surfaces which are supposed to be firmly clamped together. It is characterised by surface discolorisation, pitting which may have serious effects on the fatigue strength of the component, and the accumulation of a brown powdery deposit, mainly iron oxide, which may, by wastage, cause loosening of clamping bolts or studs, or, on the other hand, may lead to seizing in parts having a press or taper fit. The seizing of more rapidly moving parts is usually a welding effect, in which friction generates sufficient local heat to melt one of the contacting surfaces. Subsequent relative motion of the fused area tears material out of the surface and causes pits, scratches and other surface damage.

Tomlinson,[1] who was probably the first to investigate fretting corrosion, held the view that direct oxidation of the surface occurred as a result of the breakdown of cohesion due to high local temperature produced over an area of almost molecular dimensions by very small relative motion. On the other hand, the explanation put forward by Fink[2] was that fretting corrosion was due to surface irregularities undergoing plastic deformation, which renders these areas very active chemically, and that by the repeated rubbing away of the oxide film which forms at these positions, and would normally retard further attack, fresh metal is always being exposed to oxidation and the attack continues to proceed at a rapid rate. From the results of an extensive investigation, Tomlinson, Thorpe and Gough[3] concluded that the primary cause of fretting corrosion is of a mechanical rather than a chemical nature, and they give reasons for stating that the corrosion is due to attrition of the surfaces on a molecular scale, and not simply to a mechanical grinding or abrading effect. Many attempts have been made, by testing in the absence of oxygen and moisture, in nitrogen and in a vacuum, to ascertain whether the chemical or the mechanical effect predominates, but with contradictory results. According to Fink[2] and to Almen[4], the effect is reduced but not eliminated in nitrogen or in a vacuum. On the other hand, Rosenberg and Jordan[5] found greater wear and more roughening in an atmosphere containing no oxygen than in one which contained oxygen, the abraded particles being metallic iron. They found that a thin film of oxide on the wearing surfaces of carbon steels resulted in a certain degree of protection against wear.

The subject of fretting corrosion has been discussed, both from the practical and theoretical viewpoint, in recent publications.[6] According to a paper by H. Schottky and H. Hiltenkamp, translated by R. G. Sartorius,[7] atmospheric nitrogen plays a part in the fatigue failures which are sometimes the result of fretting corrosion. At the Krupp Laboratory, Essen, there have been on record for many years observations to the effect that fatigue failures of leaf springs often start from lightly rubbed areas on the surface where the presence of friction rust cannot be found. In the metallographic investigation of these springs and other parts, the indications became stronger that it was not oxygen, but rather nitrogen, which had a strong influence on surface destruction by galling. To obtain analytical proof a microchemical method, devised by Klinger and Koch, was employed. Chemical analysis of scrapings from a leaf of a clutch spring showing a friction spot, which when etched had a network standing in relief, gave the following results :—

	Nitrogen, per cent
Friction spot	0·090 and 0·074
Surface outside friction spot	0·0065
Interior	0·006

The same spring was analysed by a solution method of sampling, giving results shown, together with those for two silicon steel spring leaves, in Table I. Chemical analysis thus confirms the increase in nitrogen and further shows that the less oxide is present the higher is the nitrogen content. Similar analyses on the tooth of a badly worn gear wheel gave, to a depth of 0·04mm, an average nitrogen content of 0·013 per cent in a severely roughened part, 0·008 per cent in a little worn part, while the nitrogen content of the interior was 0·004 per cent. Scrapings from the point of fracture of a badly worn nickel-chromium steel gear showed nitrogen 0·04 per cent in comparison with 0·006 per cent in the interior. These results were held to prove that under severe friction, not only oxygen but nitrogen also is absorbed from the atmosphere. In further support the authors quoted observations showing that absorption of nitrogen takes place during the machining or grinding of micro sections of soft iron.

TABLE I.—*Nitrogen Contents (Schottky and Hiltenkamp)*

Surface characteristics	First layer		Second layer		Interior
	Depth, mm	Per cent N	Depth, mm	Per cent N	Per cent N
Very heavy oxide deposit	0·072	0·013	—	—	0·007
Medium oxide deposit	0·035	0·015	0·063	0·011	0·007
Rough with slight oxide deposit	0·050	0·019	0·056	0·013	0·007
Smooth, bright	0·029	0·034	0·071	0·007	0·007
Smooth, lustrous...	0·035	0·012	0·071	0·008	0·005
Highly lustrous	0·095	0·019	—	—	0·005

First four, Mn steel : carbon, 0·60, manganese 1·50 per cent. Last two, Si steel : carbon 0·40, silicon 1·50 per cent.

Since the formation of nitrides starts at the grain boundaries the occurrence of some brittleness and crumbling of the surface layers may be understood, but the examples given do not all appear to be typical of fretting corrosion.

Whatever may be the primary cause of fretting corrosion, experience has shown that it only occurs as a result of slipping or rubbing motion, which may involve only very slight relative movement. The severity of fretting corrosion is increased with more highly finished surfaces : hard metals are more affected than soft ones, in the sense that they produce more corrosion debris, though softer materials may show a greater tendency to seize as a result of welding action ; and surfaces of like materials are more susceptible than those of unlike materials. Chromium plating, though hard, is not reactive and has been found to be effective in reducing the severity of fretting corrosion. A high resistance to fretting is found in combinations in which one of the metals is nickel. Stainless steel in any combination, but especially upon itself, is the most susceptible material. Numerous suggestions have been made for preventing the effect.[6] Improved lubrication to exclude air is usually successful, and especially the use of special lubricants (containing, for example, aluminium soap) which combine low viscosity with the property of maintaining a continuous film. The interposition of soft material such as a thin coating of aluminium paint, between two hard surfaces, or the elimination of slip by roughening or serrating the faces in contact may reduce susceptibility to fretting corrosion. Shot peening is advantageous in causing roughening accompanied by internal stress. The introduction of favourable compressive stresses at the surface by mechanical means, such as surface rolling or shot peening, or by surface treatments, such as nitriding or carburising, reduces the tendency to form cracks which lead to fatigue failures.

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Chromium-Free Heat-Resisting Steels

IT has long been known that chromium is an alloy element of outstanding value in conferring on steels a high resistance to scaling at temperatures of 800 deg. to 1200 deg. Cent., but the addition of silicon or of aluminium has been a recognised method of improving that resistance. The action depends on the high-temperature stability of the oxides of these elements. Although a much larger amount of chromium than of aluminium or of silicon is required to produce equal resistance to scaling, chromium as the main addition has the advantage of giving steels with much better mechanical properties. Alloys of iron with more than small percentages of silicon or of aluminium tend to be brittle and behave badly in forging or cold working. After slight deformation, heating at a high temperature causes excessive grain growth and consequent brittleness. Oxide formation (on which the non-scaling value depends) leads to difficulties in melting and casting. The protective oxide layer produced by chromium has good adhesion to the surface : the alumina or silica protective skin is liable to flake off on heating and cooling, exposing a new surface to attack. The tendency of aluminium to combine with nitrogen also has a detrimental effect on the protective layer. Silicon is generally preferred to aluminium as an addition to chromium heat-resisting steels, but steels with upwards of 7 per cent chromium and 2 to 4·5 per cent aluminium show high resistance to oxidation at temperatures above 800 deg. Cent. depending on the quantities of chromium and of aluminium present. Steels with 20 to 30 per cent of chromium and about 5 per cent of aluminium (with or without about 2 per cent of cobalt) can be advantageously used as heating-element materials. All the iron-chromium-aluminium alloys are brittle at room temperature but have better properties at elevated temperatures.

The shortage of chromium in Germany during the war led to a search for chromium-free heat-resisting steels, and in spite of the unpromising mechanical characteristics of aluminium steels, these were investigated for scaling resistance, strength, working properties and weldability, in the hope that additions of silicon, titanium or manganese might successfully counteract the tendency to large grain size and brittleness. This work has been described by W. Völker,[1] who prepared a large number of aluminium steels with various additions, and also some titanium steels with 1 to 12 per cent of titanium, in 10kg H.F. furnace casts, some selected compositions being made in 50kg ingots also. It was observed that, whereas a 10kg ingot of 14 per cent aluminium steel was forgeable, much greater care was required in forging a 50kg ingot with 7 per cent of alumi-

nium. It was early concluded that no success was to be expected with any steel containing as much as 10 per cent of aluminium; and, similarly, it was possible to eliminate aluminium-silicon steels containing more than 3 per cent of silicon and aluminium-titanium steels with more than 1½ per cent of titanium on account of their great brittleness.

Resistance to scaling was determined in specimens, 5mm by 25mm by 50mm, by heating for 120 hours with cooling in air every twenty-four hours, removal of the scale with ammonium citrate solution or molten alkali-cyanide and determination of loss of weight. Tensile and bend tests were also carried out. Three compositions emerged as promising, the carbon being 0·05 and the manganese 0·3 to 0·5 per cent in each case :—

Silicon, per cent	Aluminium, per cent	Titanium, per cent	Resistant up to deg. Cent.
1·5	3·5	0·3	900
1·5	4·5	0·5	1000
0·7	7·0	1·0	1100

A 50kg ingot of steel of the intermediate type (containing C 0·07, Si 1·76, Mn 0·32, Al 4·80, and Ti 0·36 per cent) was forged to plate by light blows and then rolled to 5mm sheet. Longitudinal tests on annealed specimens gave tensile strength 41·3 tons per square inch, yield 36·8 tons per square inch, elongation ($L=5d$) 16·5 per cent. Scaling at 1000 deg. Cent. was less than 0·1 gramme per square metre per hour compared with 0·94 for the 3·5 per cent aluminium steel. From this sheet a carburising box was made by welding with austenitic electrodes; ferritic electrodes were not tried. Machining offered no difficulty. This box was used in sixteen treatments for 180 hours at 780 to 1000 deg. Cent. without showing any indication of weld-seam or surface damage, the surface having assumed a grey matte appearance. A 50kg ingot of steel containing 7 per cent of aluminium and 1 per cent of titanium could be forged with care at 1000 deg. Cent., but when forged at a higher temperature it became covered with fine surface cracks. These steels are purely ferritic in structure and have very low impact values. G. Hoch[3] made some assessment of the relative tendency to brittleness of various steels by carrying out notched-bar impact tests at 250 deg. Cent. The results are given below; all the steels contained carbon 0·08 to 0·10, silicon 0·14 to 0·57, manganese 0·60 to 0·91 per cent, and they all had impact figures of under 1kg-m per square centimetre at room temperature :—

Notched Bar Impact Tests at 250 deg. Cent.

Aluminium, per cent	Added element, per cent	Impact value kg-m per square centimetre
6·63	—	29·1
8·35	—	28·0
10·70	—	0·6
6·23	1·00 Ti	14·6
8·17	1·09 Ti	12·8
10·90	1·32 Ti	0·7
6·25	1·42 V	30·3
8·43	1·53 V	26·7
10·82	1·46 V	0·6
6·45	3·11 Cr	30·2
8·73	3·18 Cr	29·1
10·80	3·13 Cr	0·6

The range of compositions recommended by Völker as likely to be serviceable in the temperature region of 800 to 1000 deg. Cent. is aluminium 3·5 to 7, silicon 0·5 to 2·5 and titanium up to 1·0 per cent. The carbon content should be as low as possible and the titanium equal to six times the carbon or, with high aluminium, 1·0 per cent. Though resistance to scaling improves with increase in aluminium, the accompanying mechanical properties deteriorate, and, as indicated above, at the high limit of aluminium the alloys become difficult to forge.

As probably equivalent in resistance to scaling up to 800 deg. Cent., but superior in mechanical properties to steel at the low limit of the above range, Völker suggests an austenitic-ferritic chromium-free steel containing carbon 0·1, manganese 17·0, aluminium 4·6, and silicon 1·4 per cent, readily workable and having good weldability. This material in 5mm thick, hot-rolled strip, after being quenched from 1050 deg. Cent. (in which condition it was weakly magnetic) gave a tensile strength of 40·6 and yield of 25·4 tons per square inch, with an elongation ($L=5d$) of 55 per cent. Scaling at 800 deg. Cent. was 0·85 grammes per square metre per hour, compared with 0·21 for the steel with aluminium 3·5 and silicon 1·5 per cent, and with 25·1 for unalloyed mild steel.

This investigation, though justified by the circumstances in which it was undertaken, does not disclose any prospect of attaining as high a standard of mechanical properties combined with resistance to scaling in chromium-free steels as in the more usual heat-resisting steels.

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Ductile Titanium

ON account of the possible applications of ductile titanium renewed attempts are being made in America, Australia and elsewhere to develop methods of manufacture and working of the metal. Metallic titanium has been prepared in small quantities in a ductile condition since the beginning of the century. M. A. Hunter reported in 1910 that he had obtained a malleable product of 99·9 per cent purity by the reduction of titanium tetrachloride by sodium in a closed container. A. E. van Arkel (1934) and J. D. Fast (1939) prepared small quantities of malleable titanium by the thermal decomposition of titanium iodide. W. Kroll (1941) employed the tetrachloride, using magnesium as the reducing agent. Two methods of manufacture are under development in America. The U.S. Bureau of Mines is producing, on a pilot plant scale, ductile titanium from the tetrachloride reduced by magnesium in an atmosphere of helium.[1] The Battelle Memorial Institute, in a research sponsored by the Remington Arms Company, is using the method of thermal decomposition of the iodide and producing 300–600 grammes per run.[2] The products can be swaged into rods and drawn into wire.

Tests made on the Bureau of Mines titanium in the form of annealed sintered compacts,

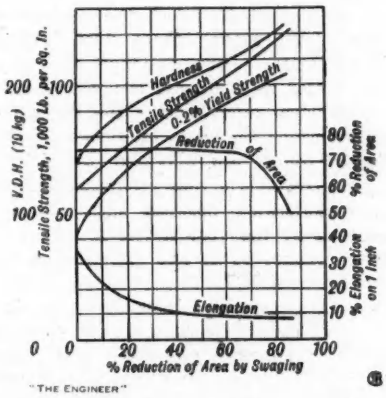

FIG. 1—*Tensile Properties of ½in Cold-Swaged Titanium Rod with Various Amounts of Cold Reduction. (Campbell and Others.)*

0·38in thick, subsequently cold-swaged to various sizes of strip with intermediate annealing in a vacuum, showed a tensile strength of 78,700 lb (35·1 tons) per square inch, increased by cold work to 123,000 lb (54·9 tons) per square inch at 50 per cent reduction of area, and then falling off again. The elongation of the annealed strip was 25 per cent on 2in, falling to about 8 per cent at 20 per cent reduction of area, remaining approximately constant up to 50 per cent reduction of area, and then dropping rapidly when the cold work exceeded 50 per cent.[1] The electrical properties of the Bureau of Mines product have been examined[2] and from electrical measurements the temperature of transformation from the close-packed hexagonal structure, which exists at room temperature to the body-centred cubic structure stable at high temperatures, was found to occur at 885±2 deg. Cent. The lattice constants of the hexagonal structure at 25 deg. Cent. were found to be :

$$a=2\cdot945_6 \quad c=4\cdot684_5 \quad c/a=1\cdot590_7$$

The linear coefficient of expansion between 30 deg. and 200 deg. Cent. was $9\cdot0\times10^{-6}$ per deg. Cent. The electrical resistivity at 20 deg. Cent. was 55 microhm-cm, which is very high for a pure metal. The temperature coefficient at 20 deg. was 0·183 microhm-cm per

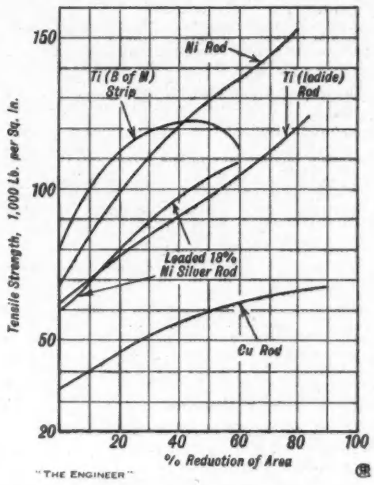

FIG. 2—*Effect of Work Hardening on Different Metals. (Campbell and Others.)*

deg. Cent., which, in proportion to the value of the specific resistance, is about the same as for metals of high conductivity, for example :—

	ρ	$d\rho/dt$ at 20 deg. Cent.	$1/\rho \cdot d\rho/dt$
Ti	55·0	0·183	0·0033
Cu	1·7	0·007	0·004

The resistivity of this material was somewhat higher than that found by Fast for titanium made by the iodide method (viz., 42 microhm-cm), and the work of the Battelle Institute[2] shows that there is a distinct difference between the products of the two processes. Thus the Vickers diamond hardness of the iodide titanium when annealed was at the most 130, whereas the hardness of the annealed Bureau of Mines product was 75 Rockwell G (=98 Rockwell B) or 225 V.D.H. At the same time the iodide titanium had a larger capacity for cold work, these differences being attributed to its greater degree of purity with reference to oxygen, nitrogen and carbon.

The effect of cold working on the mechanical properties of titanium prepared by the iodide method is shown in Fig. 1. The tensile strength of the annealed rod was 26·8 tons per square inch, rising continuously with cold work to about 54 tons per square inch at 85 per cent reduction of area. The elongation on 1in fell rapidly from 35 per cent for the annealed rod to 15 per cent after 20 per cent reduction, then much more slowly so that it was still about 8 per cent at 85 per cent reduction. The ratio of tensile strength (tons per square inch) to Vickers hardness was 0·19 in the lower range and 0·21 in the upper range of tensile strength. Fig. 2 gives a comparison of the work-hardening capacity of titanium in relation to that of other well-known metals; it also shows the difference in behaviour of samples of titanium made by the two different methods.

It would appear from these investigations that the iodide method, though at present the more limited in output, is the more promising means of producing titanium metal of high purity and maximum ductility.

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ALL-ELECTRIC INTERLOCKING

DURING the past twenty years the art of railway signalling in Great Britain has been in course of rapid evolution. The installation at North Kent East Junction, Southern Railway, in 1929, of the first locking frame in which the lever interlocking was accomplished electrically instead of by purely mechanical means marked a break-away from traditional practice that has been followed by a series of notable developments. In this series the new signalling recently brought into service at Doncaster, and described in last week's issue, marks a new stage. Once the hitherto traditional mechanical interlocking had been dispensed with, inventive minds were looking towards the replacement of the lever itself. Electric interlocking had reached a very high degree of reliability and the next stage was to introduce relay, or circuit interlocking, wherein the condition for the safe operation of a signal, a pair of points, or even a complete route, was the making-up of a circuit through the contacts of a series of relays proving that the various conditions required were actually fulfilled. The operating member so far as the signalmen were concerned, needed to be no more than a thumb switch. But while this innovation made the control machine still more compact, it included one feature on which some older signal engineers looked with disquiet. Hitherto, if a signal or pair of points could not be used, owing to other track conditions, the lever was locked; in the new relay interlockings, as they became known, the thumb switches were not locked at all. The electric interlocking through the various proving relays afforded all the protection that was required.

Once the principle of using non-interlocked levers or thumb switches was conceded, the way was open for some ingenious variations of the one basic scheme. At Thirsk, route working was adopted, and the switches grouped on the illuminated track diagram near to the point of entry to the route. At Leeds West box, where the complications of a large city station would have rendered the route working very involved, individual thumb switches were provided on the track diagram for every signal and every pair of points. At Hull, installed in 1938, a reversion was made to a separate track diagram as with the conventional form of locking frame, and the route switches were grouped on a sloping keyboard below. Meanwhile, discussion ranged round the relative merits of having the switches on or off the diagram and two further methods of route working were introduced. The first was the "Entrance-Exit" system, in which two functions had to be operated in order to set up a route; a switch at the point of entrance and another one at the point of exit—both switches being at their correct geographical position on the track diagram. The second method was the system put into service for the first time at Doncaster on January 9, 1949. In this again the switches are on the track diagram, but at points where a number of diverging routes may be signalled a single rotary switch is used, which, by turning to one of a series of positions, can be caused to select the appropriate routes from among those possible from those points. But although the panel switch used at Doncaster is novel in itself, the principal innovation is the method of accomplishing the route interlocking. Conflicting routes are allocated to different angular positions on rotary sequence switches and interlocking between such routes is achieved by the very simple fact that the switch cannot be in two angular positions at the same time.

In making comparisons between these forms of control panel and the orthodox power frame, with all-electric interlocking between the levers, one cannot, of course, confine the argument to matters of operation. The compactness of the modern control panel is not achieved without a considerable increase in the number of relays normally housed in the signal-box, and generally speaking a relay interlocking will be higher in first cost than a power frame to do the same work. But a relay interlocking, arranged on one or other of the route systems, may well show a considerable reduction in the number of lever movements, and a reduction in operating personnel may be possible. The introduction of sequence switch interlocking, as at Doncaster, brings some new factors into the general consideration of electric interlocking practice; for the physical interlocking possible with this system brings about a very considerable reduction in the amount of cabin equipment. But, in addition to purely operating costs, there are maintenance charges to be borne in mind. In this connection there are, in North-Eastern England, several signalling installations very similar in size and in the nature of their traffic which could provide some interesting comparisons. Darlington South signal-box, for example, is equipped with an all-electric lever interlocking frame, while Hull Paragon station has a route relay interlocking with thumb switches on a keyboard below the diagram. It would seem that extensive experience is needed of the all-round performance of these different forms of all-electric interlocking before it could be established which is the more generally suitable. But in any case it is pleasant to record these enterprising developments in signalling practice; up to the outbreak of war, in 1939, Great Britain was leading the way in the design and installation of relay interlockings, and in this latest development, the use of the sequence switch, the new signalling at Doncaster is the first of its kind anywhere in the world.

AGRICULTURAL AIRCRAFT

THE favourable reports which one reads in the lay press of the results of experiments with new forms of insecticide for attack on agricultural pests raises in the mind of an engineer the very practical question of what is likely to be the most feasible way of applying such remedies to the sore spots. The areas to be treated may be very different in their surroundings; the requirements may be the spraying of trees or bushes in a highly developed country, or, at the other end of the scale, of treating in the future vast areas in Africa, whether pasture, crops or wooded land. A pioneer effort of this kind was made in the 'twenties of this century, when it was decided to attack the locust pest in the northern parts of South Africa. As it was not then known whether ground attack or air attack would prove the more effective, it was thought advisable that an expert committee of biologists and entomologists should be appointed and be strengthened in its personnel by the addition to their number of an engineer with aeronautical experience. Incidentally, this addition to the committee led to a rather humorous situation when, during one of the committee's discussions, it was seriously proposed from the biological side that wherever it was required that a locust swarm should be attacked, whilst in flight, by means of a poison dust trail laid by an aircraft, the appropriate procedure would surely be for the aircraft to lay the trail as it flew along the windward side of the swarm, leaving it to the wind itself to carry the poison dust right through the long cloud of locusts. The aeronautical expert had, alas, to point out that if such a plan were really adopted it could but lead to no scrap of the dust reaching any of the locusts, for the side wind would move locust and dust in just the same way and by just the same amount; so that (unless the swarm was heading directly into the wind) if they began apart they must stay apart! The correction was received with good humour and in the end it was unanimously decided that, without bothering about the direction of the wind, the trail would after all be best laid in front, and across, the head of the

swarm, leaving it to the insects to fly through it.

This plan was fully tested in experimental flights in Rhodesia, and though the locust mortality it produced was almost all that could be desired, it had to be abandoned because the poisonous dust which reached the ground led to most embarrassing claims against the Government by farmers whose cattle, as was alleged, suffered by eating the dust-sprinkled herbage. Prior expert opinion which had been taken was that the effect on domestic herds could but be that of a mild stimulant; but the thrifty farmers thought they knew better! So the air attack was abandoned and was replaced by ground operations by native labour, which made use of poison bait with long trench lines dug across the path of the approaching hoppers, as the locusts are termed before they have grown their wings. Chemical discoveries made many years later would, no doubt, had they been known in time, have led to the replacement of the arsenical poison by such notoriously safe substances as DDT, against which no legal action by even the most persistent farmer would be likely to prevail. From a recent issue of *Nature* we learn that the South Africans have had great success with a DDT smoke, put down from the air, over a small game reserve. So it is not impossible that aircraft attack against locusts may be renewed.

Against flying swarms the aircraft would usually be able to operate at a reasonably safe flying height, in which case either aeroplanes or helicopters could be chosen for the task. But on the whole it seems that much the more promising use for agricultural aircraft will prove to be crop dusting of some sort. Crop dusting is much better effected by a very slow-speed craft than by a fast one, and is likely to be far more effective if the dust can somehow be impelled downwards by a vertical slip stream. Both these considerations point to the helicopter rather than to the fixed-wing type of aircraft. There is, however, the consideration that in many cases the best height for attack will be just above the tree tops. So low a height of flight presents some difficulty, since, in the event of engine failure, there is little air-room for the requisite change in pitch of a helicopter rotor, and the necessary reversal in direction of the air flow through it, before impact with the ground. It is true that in such a novel craft as the all-purpose Cierva "Air Horse," which made its maiden flight in December last, and whose name suggests an appeal to farming interests, it is claimed by its designer that an unusually long-travel undercarriage should suffice to ensure that there should be no "danger zone" in vertical descent. If this claim is borne out in practice, it may be that such a craft would find a substantial use in work of this category. As on its first flight, the gross weight lifted was over 6 tons—perhaps the most ever raised by a rotary-wing aircraft—there should be capacity for carrying a load amply sufficient to meet the needs of the farmer. It has yet to be made clear, however, what degree of stability such a helicopter has and what would remain if by some mischance one of the three rotors of this ingenious machine were to fail. Preliminary work carried out in this country and elsewhere on this and other such problems will, we gather, form one of the items to be discussed with our American friends at the joint meeting of the Institute of Aeronautical Sciences and the Royal Aeronautical Society to be held on that side of the Atlantic in May and June of this year. Their conclusions will be awaited with interest.

Obituary

WALTER HENRY PURNELL

It is with deep regret that we have to record the death of Mr. Walter Henry Purnell, the chairman of Herbert Morris, Ltd., of Loughborough, wnich occurred peacefully in his sleep at his home, Burton Walks, Loughborough, during the night of January 18th. His death deprives the engineering industry of a leader of great ability and wide experience. He was, we may recall, one of a small band of young men of promise which the late Mr. Herbert Morris gathered round him during the period in which he raised his business from small beginnings to a firm of international repute. It was a fitting tribute to Mr. Purnell's earlier services to the company that when its founder died he was unanimously chosen to succeed him as chairman of the company. Walter Henry Purnell was born at Trowbridge in 1869, and he received his early engineering training in Cardiff. After a few years with a firm of agricultural engineers in Southern Ireland, Mr. Purnell joined the firm of Herbert Morris, Ltd., at Loughborough, in 1899. Nine years later he was made a director of the company, and in 1920 its vice-chairman. On the death of the late Mr. Herbert Morris, Mr. Purnell was, in 1931, elected chairman of the company, a position he continued to hold until his death. He was proud to claim that during his long association with the business he had successfully occupied every one of its higher executive positions, on both the manufacturing and commercial sides of the business. He was a member of the Institution of Mechanical Engineers, which he joined in 1908. Outside his many business interests, he found time for public interests and besides being a County Justice of the Peace, he was a Governor of both the Loughborough College and the Loughborough Hospital. He will long be remembered as one whose warmhearted personality made for him many friendships, both in this country and overseas, and those who were privileged to work closely with him for so many years will feel a deep sense of loss.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

PERSONNEL MANAGEMENT AND WORKS MANAGERS

Sir,—In Mr. A. K. Rice's stimulating article in The Engineer of December 31, 1948 (page 667) so many people—directors, works managers, personnel managers and workers—are taken to task that it is a little difficult to frame the reply his time and trouble deserve. This difficulty is increased in that Mr. Rice, in the first part of his article, appears to be carrying the flag for a particular approach to industrial relations known as "group participation." The villains of his witch hunt are specialist personnel managers, but whether they are singled out as being bad in themselves or just bad as a possible hindrance to the development of the group approach is not made very clear.

Mr. Rice says that personnel management is "that function of management which deals with the personnel problems of people at work." He is entitled to his own definition but he elaborates its implication to cover the whole unhappy state of modern economic man. "Work," he says, "is the means by which man obtains his living from his natural surroundings and the problems of people at work are our own problems in our own day-to-day activities and personnel management therefore is that function of management which deals with us and our working lives." That is certainly one way of saying that few of us like working in factories and are frequently quarrelsome and unreasonable as a result.

What is not quite fair is his implication that personnel managers sell themselves as specialists, claiming to cure these ills, and that because industrial society is still sick, personnel managers have failed to deliver the goods. Personnel managers make many claims for the service they can render and there are even enthusiasts among them who give the impression that industry exists more for the scope it gives their work than for the more conventional purpose of making goods for sale. But I doubt if even those extremists with a crusading fervour equal to Mr. Rice's own have ever aspired to the missionary status Mr. Rice has thrust upon them or felt inadequate when they have failed to work miracles.

Surely the truth is that human relations in our modern industrial society, both inside the factory and out, are the responsibility of each one of us in whatever position we may find ourselves. The higher a man goes the greater that responsibility becomes because of the widening effect his example, judgment and decisions can have on those who depend on him. At every stage from operator to chairman of the board there is an obligation towards others—a fact which used to be recognised and uncompromisingly stated when men asked for help to do their duty in that state of life unto which it had pleased God to call them. They did not ask for a personnel manager to do their duty for them, and I do not think they do so now. They ask him simply to do a very necessary job for industry and, speaking as a works manager, I find they get some fine and useful work in return.

In any factory men have to be recruited, trained, placed, paid, discharged, provided with statutory working conditions, fed, doctored, retired, pensioned and, above all, given a chance to have a say in the things that affect their working lives. In a large factory—say, 750 and upwards—this is a full-time administrative job for a specialist personnel manager. It is to the credit of their profession that it is so often admiraby done by one or other of the many hundreds of first-class men and women who make up their number and who, in addition to the routine side of their job, so often help with sound and timely advice on the human relations with which they, along with the rest of us, deal.

P. D. Pattrick

Petts Wood, January 14th.

Sir,—In his article on this topic, Mr. A. K. Rice has written from the standpoint of those already in management who see new functions introduced into "their established, secure and

traditional background," an attitude not conducive to the establishment of a full-rounded view, and has argued from the astonishing dictum that the introduction of new functions implies failure on the part of those already in the organisation. Had Mr. Rice followed this argument to its bitter end, he might have left works management serenely insulated in its sphere of control, but would have swept away, with personnel management, such other helps to efficiency as costing, planning and production control. These are all specialised aspects of management.

May I commend to your readers the functional view of personnel management, that attention to the problems of getting men and women of every rank to work together in an organisation is, in varying degree, the responsibility of management as a whole. The lines which this attention is to take will be laid down by the managing director in the form of a labour policy binding on everybody, including the works manager and his foremen. To help the works manager in carrying out this policy and to advise him on its multitudinous details, the managing director delegates his own powers of control in the form of advisory authority to the personnel manager. Where this authority has been accurately defined and its limits understood, personnel managers are, in my experience, welcome members of the management club.

C. H. NORTHCOTT

York, January 17th.

WAR SURPLUS MACHINE TOOLS

SIR,—During the war years the demand for gear grinding and spline grinding machines was extremely heavy and the output of our machines was many times more than any normal consumption. A great many of the machines have been offered for disposal through the Government pool and auction sales. Many purchasers have been buying such machines without due knowledge that some of these machines were built for special requirements, with very unsatisfactory results to themselves and, unfortunately, sometimes resulting in rather wrong impressions of our desire to co-operate with any users of our machines.

What happens in so many cases is, a user buys one of these machines at what is apparently a very low figure indeed, then, when he wants to start it up, gets in touch with us. Invariably we find inaccuracies, shortage of the right equipment, and sometimes machines which cannot be adapted at all, having been built for a particular job. The position has become a very acute one and, unfortunately, we now have to take steps to advise that we can take no responsibility for the proper operation of machines which are bought without consultation with us. All of this can be very expensive and sometimes unsatisfactory to both the user and ourselves.

I have no doubt that there are other manufacturers of specialised machines who are finding themselves in similar difficulties, therefore I am writing this letter in the hope that you will publish it and that it will be a helpful guide to potential users of ours and other specialised machines.

A. H. ORCUTT
(Managing Director)
THE GEAR GRINDING COMPANY, LTD.

Birmingham, January 19th.

LOCOMOTIVE COMPARISONS

SIR,—Mr. Sterndale, in his letter of December 31, 1948, offers some useful criticisms of the outline design which accompanied my letter of November 6, 1948, under this heading. I welcome the points he has made and am very glad he has raised them.

As a preliminary to replying to his three sub-headings, I should explain that my diagram is an adaptation of an original design for an oil fired articulated locomotive, incorporating a suggested heat recovery system; some compromises were therefore necessary. Taking the points raised by Mr. Sterndale :—

(1) *Articulation.*—The distance between the adjacent driving wheels of the two units is given as 36ft 3in; I agree with the criticism that the coupling arrangement should be improved upon. This could be achieved by modification of the firebox, such as the adoption of the legless water tube design, as described by Mr. Poultney in his article on "High-Pressure Locomotive Boilers," in THE ENGINEER of December 17, 1948, and used by Mr. O. V. Bulleid in a modified form in his new "Leader" class design. It would then be possible to extend the frame of the rear unit further forward and thus improve the coupling system accordingly. In actual practice the steps leading to the driving compartment would have to be arranged in two parts to permit of the movement of one frame over the other.

(2) *The Boiler.*—The intermediate box is designed to avoid overlong tubes; the balanced draught provided in the "heat recovery" design takes care of this. I agree that in normal practice this may not be desirable; with a special legless firebox design, however, I think this intermediate box could be dispensed with, without resorting to an unduly long barrel and long flue tubes.

The firebox as at present designed has a very wide base and gives a grate area of about 65 square feet, but is intended for oil firing rather than for solid fuel.

The boiler heating surface is made up as follows :—

		Square feet
Long barrel :	158 2¼in o.d. tubes	1730
	45 5⅛in. o.d. flues	1175
Short barrel :	50 2¼in o.d. tubes	195
	64 5⅛in o.d. flues	570
		3670
Intermediate box and firebox		330
Evaporation total		4000

With efficient combustion this should be ample; to obtain 4500 square feet a slight increase in tube length would be necessary.

With adequate draught I do not think the smokebox temperature would be unduly low; some of the American locomotives described by Mr. Poultney in his articles on the subject are working successfully with very long boilers.

(3) *The Engines.*—I agree that if solid fuel is to be used some modification of the rear engine will be necessary. Two outside cylinders of 20½in diameter would be a solution. In the original design the adhesion weight of the rear unit is obtained in part from auxiliary diesel-electric equipment, &c.; hence the rather vague fuel and water distribution indicated in the adapted diagram for a "straight" locomotive some compromise would have to be accepted. Again, the original design provides a common superheater serving both engines and is a rather complicated arrangement. To use the exhaust from the rear engine for blast purposes would involve a long and tortuous exhaust pipe and consequent back pressure trouble. A system of exhaust steam jet forced draught, on the lines of the "turbine furnace," might be considered.

Finally, I venture to hope that others will join in the discussion stimulated by Mr. Livesay's article, culminating in his proposed "Beyer-Garratt" locomotive. Mr. Poultney's lead with a projected design (THE ENGINEER, October 22, 1948) gave an opening which I was tempted to follow and which, I am pleased, has produced some constructive comment.

Your leading article, Mr. Editor, in the December 31st issue, on "The Pursuit of a Notion," is the very essence of the matter. The present position of the steam locomotive is a challenge worth accepting. Here is the opportunity for locomotive engineers with "notions" to make a contribution; unless Mr. O. V. Bulleid is alone in the field of original thought on locomotive design.

I confess that I have always found the subject fascinating and have yielded to the temptation to explore various ideas on paper. If others are encouraged to follow suit in support of the wonderful machine that has served us so well and so long, I shall feel that my temerity in putting them forward is excusable.

E. W. HERRINGTON

Edgware, January 12th.

STANDARDISED LOCOMOTIVES

SIR,—The standardisation of locomotives is a reflection of the times in which we live. It is just as much an act of Socialism as the nationalisation of an industry. It is a direct assault on individuality and is the child of economic planning. The years that remain to the familiar steam locomotive are numbered. It will sink into oblivion. Yet some shall remember the days of its greatness. The famous men who, by their individual inspiration, added to its excellence shall be praised by all save those who are so blinded by "blue prints" and planning that they can see no more in great engineering than the attainment of economic and social ends.

I write, not as one of the enthusiasts of whom you speak in your leading article, but as an old engineer, who has known many of the great locomotive superintendents and C.M.E.s. I venture to say that each one of them in the creation of a new type or class was moved by a higher emotion than the mere production of a machine to accomplish a specified purpose. They were all artists in their way. There is as much difference between them and the routine draughtsman of a standard locomotive as between the painter of the "Admiral Benbow"—inn-sign of immortal memory—and a portrait by Reynolds or Gainsborough.

The newly appointed C.M.E. is not—alas! we must say was not—moved by mere waywardness in introducing a new class of engine. He had something inside him that he desired to express, something that had been with him for years. He wanted to say his individual say, like an author or an artist or a composer. To every true engineer there is something in a perfected machine or structure that is hidden from ordinary eyes. It is not only its fitness for its pre-ordained purpose; it is the inherent beauty, fruit of inspiration, with which that object is reached. If purpose were the sole criterion—as in standardised locomotives—then a common tankard would be more valued than a goblet by Cellini, or the concrete plugs of American dams than the graceful structures of French engineers.

Let no one say that these are but the sentimental vapourings of an old man. There is much more in the respect we pay to inspired individualism than mere sentiment. It cannot be replaced by organised planning by State departments and executive committees. We shall always want leaders of thought, and leaders are not made by insemination from standard blue prints. They must be individuals, not machine-cut cogs in the social wheel, and have personal liberty to express their own ideas and realise their own aspirations. Of such were the great locomotive engineers of the past, and such would the steam locomotive still need were it not in its declining days. Well, well, perchance a dozen standardised types will be enough to see it out. Who knows? Who knows?

L.P.

January 22nd.

Gas Turbines in 1948

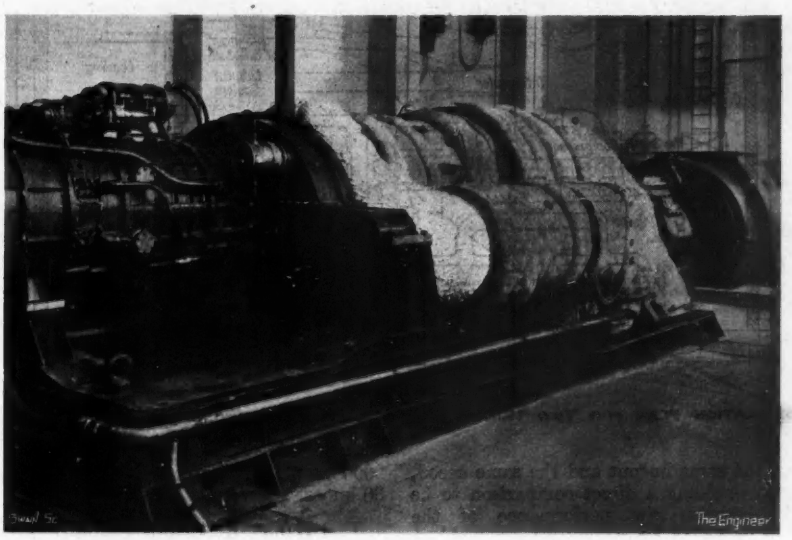
No. II—(*Continued from page 83, January 21st*)

QUITE early in 1948, the Engineer-in-Chief of the Fleet, Vice-Admiral (E.) Sir D. C. Ford, announced a programme of naval gas turbine work, which he described as probably starting a new era in marine propulsion as regards ships of war, in view of the important power-for-weight factor. Gas turbines of increasing powers have since been ordered, and in time it is hoped to use boiler fuel instead of diesel oil for naval gas turbine installations. Ultimately, it is hoped to produce gas turbines for naval ships which will have a useful life of 100,000 hours at sea.

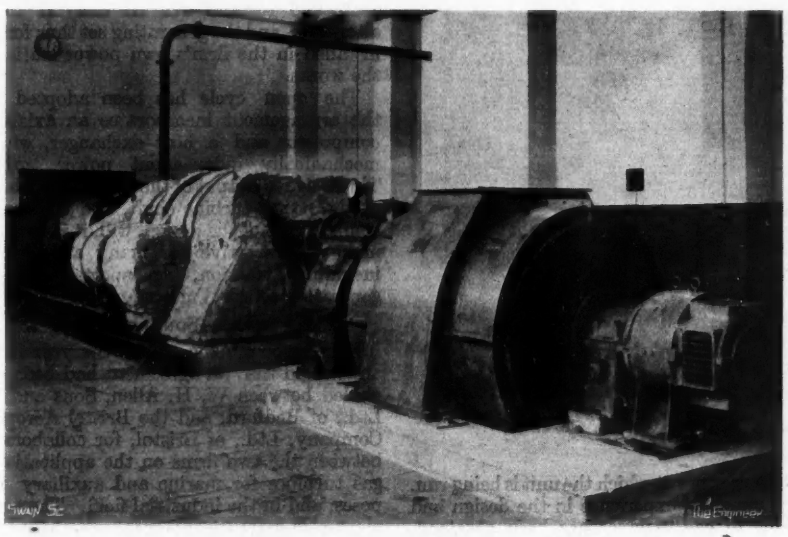
Metropolitan-Vickers Electrical Company, Ltd.

Early in February, 1948, we visited the works of the Metropolitan-Vickers Electrical Company, Ltd., and inspected the dismantled 2500 s.h.p. gas turbine which had been installed in the experimental naval craft M.G.B. "2009." The turbine had run about fifty-five hours, and we found all parts in good condition. Some illustrations of these parts were reproduced in our issue of February 5, 1948. It was announced at that time that a slightly modified 2500 h.p. gas turbine was installed in M.G.B. "2009," and afterwards that vessel made extended sea trials in the Solent with the object of ascertaining its total useful life at sea. Work on the 2500 h.p. open-cycle gas turbine for the Western Region of British Railways was well advanced, and a description of that installation will be found in the first issue of this year, January 7, 1949, on page 25.

During the year the company completed for use in its own power station a 2000-kW gas turbine-driven alternator. In the accompanying engravings we show two views



2000-KW Gas Turbo-Alternator—Metropolitan-Vickers



2000-KW Gas Turbo-Alternator—Metropolitan-Vickers

of this 2000-kW set, as seen from the turbine end and the alternator end. The gas turbine is a simple-cycle plant with a heat regenerator. The compressor which has a pressure ratio of 3·2, is driven by a single-stage turbine. The combustion gases pass from the compressor unit to a three-stage power turbine, which runs at a speed of 4500 r.p.m. and drives the alternator through reduction gearing at a speed of 1500 r.p.m.

A heat regenerator of the two-pass design is used, and this unit is installed below the floor level underneath the gas turbine plant. The air from the compressor passes through the heat exchanger and then to the combustion chambers, of which there are two, one mounted on each side of the turbine. The general arrangement of the unit is clearly shown in our illustrations. We hope to deal more fully with this unit and its performance later in the year.

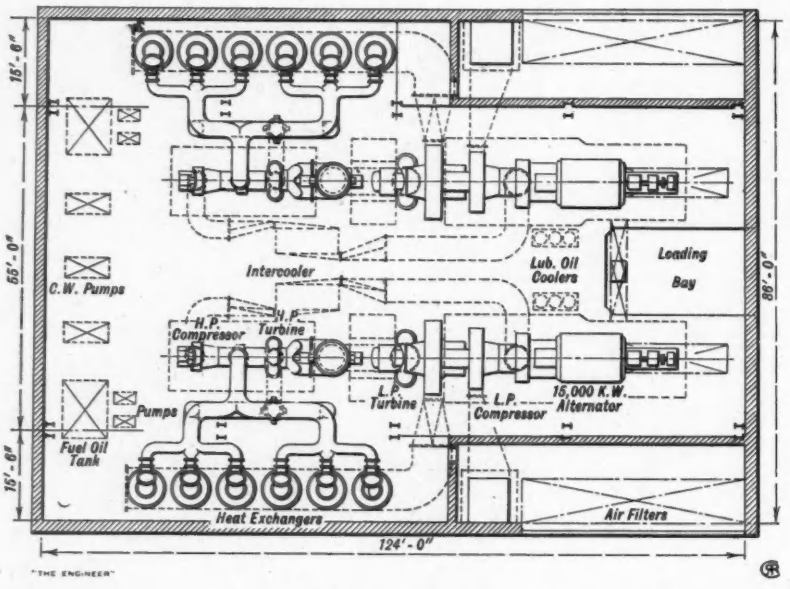
Good progress is being made, we understand, with the building of the 15,000-kW set for Trafford Park power station. In last year's review we published the cycle diagram of this set, and we show herewith the general arrangement of two such units in a power station.

Metropolitan-Vickers has also, during the year, given its attention to the possibilities of combining gas turbine and steam turbine power with pressure combustion on the steam side. In this scheme it is stated that about three-quarters of the net output of the plant is obtained from a normal steam turbine supplied with steam from a generator of the Velox type, in which combustion takes place under pressure. The arrangement makes use of a supercharged reciprocating internal combustion engine developing only sufficient power to drive its own supercharger and exhausting at a pressure of about 55 lb per square inch gauge. The exhaust from this unit, being used in the steam generating plant, is expanded in the gas turbine, thereby providing the remaining 25 per cent of the net output. The efficiency of the steam side is further increased by circulating the feed water through the supercharger coolers, the internal combustion engine jackets, and the usual heater in the gas turbine exhaust. According to figures given by Dr. R. W. Bailey in his contribution to the discussion on the papers on "The Engining of Cargo Vessels of High Power," read before the Institute of Marine Engineers in 1947, for a 12,000 s.h.p. unit, when using 1000 deg. Fah. gas temperature and 850 deg. Fah. steam temperature, the efficiency of such an arrangement would be equal to a conventional gas turbine plant operating with a maximum temperature of 1250 deg. Fah. It is pointed out, however, that a higher efficiency can be obtained by the additional complication of reheating on the steam side.

The English Electric Company, Ltd.

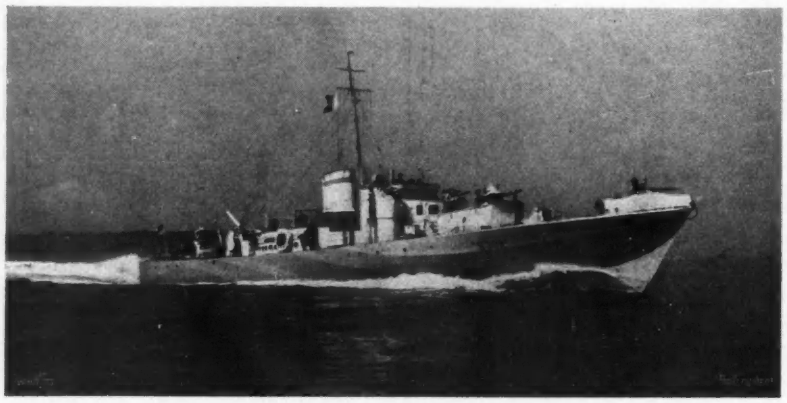
The English Electric Company, Ltd., has under construction in its Rugby works one of the largest marine gas turbines yet ordered from any maker in this country for the Admiralty. The set, we are given to understand, is not an adaptation of any existing design, but an entirely new design to suit the main propelling requirements of one of the "Captain" class frigates. The actual ship for this experimental installation has already been selected, and the machinery will be installed on her following the completion of a series of preliminary shore tests. As the existing

machinery in the frigate selected is turbo-electric with steam turbine-driven alternators of 6600 h.p. running at 5600 r.p.m., it will be possible to design the gas turbines for steam twin-screw machinery of Metrovick design, consisting of single-reduction geared turbines taking steam from water-tube boilers and designed for an output of about



INSTALLATION PLAN FOR TWO 15,000 KW GAS TURBO-ALTERNATORS FOR TRAFFORD PARK

about the same output and the same speed, thereby enabling a direct comparison to be made between the performance of the frigate propelled by steam and gas turbines respectively. Although this installation is largely in the nature of an experiment, it will nevertheless be used in order to gain experience at sea by making extended trials which will be planned to cover all ambient and operating conditions likely to arise in actual naval service. The specification for the gas turbine machinery calls, we understand, for characteristics of machinery



H.M.S. "GREY GOOSE"

life, reliability, and economy comparable with those for normal steam machinery.

ROLLS-ROYCE, LTD.

During the year Rolls-Royce, Ltd., of Derby, received the contract from the Admiralty for the powering with gas turbine machinery of H.M.S. "Grey Goose," a gunboat of some 250 tons, which is considerably larger than the M.G.B. "2009." We illustrate the "Grey Goose" herewith. She was built by John Samuel White, of East Cowes, and is now propelled by light-weight

8000 s.h.p., which give her a speed of about 30 knots.

THE BRUSH ELECTRICAL ENGINEERING COMPANY, LTD.

For some time the Brush Company has interested itself in gas turbine work, and research work has been done using a blade testing rig, comprising a single-stage turbine coupled to a centrifugal compressor. The apparatus is so designed that various quantities of air can be bled between the turbine and the compressor, depending on the temperature at which the unit is being run. By this means, experience in the design and running of gas turbines has been obtained. At the present time a 2000-kW gas turbine set has been put in hand. This unit will be of the commercial type suitable for use in industry.

PAMETRADA

The work which is being done by the Parsons and Marine Engineering Turbine Research and Development Association in its Wallsend-on-Tyne laboratories is described in Dr. T. W. F. Brown's thirteenth Parsons' Memorial Lecture, and some reference may be made to it. For the Admiralty, work is proceeding on the burning of heavy oils in gas turbines. When this has been achieved it is the intention to proceed with the development for trial purposes of a gas turbine of about 15,000 s.h.p., which will use as its fuel the oil now specified for use in naval boilers.

The design of a 3500 s.h.p. gas turbine complete with manœuvring couplings and speed reduction gear for a shaft speed of 85 r.p.m., was completed some time ago and the work of constructing this unit was allocated among eleven member firms in order that wide experience of gas turbine work could be obtained. The inlet temperature to both the h.p. and l.p. turbines is 1200 deg. Fah., and the low-pressure compressor has a ratio of 2·04 : 1, while the high-pressure compressor has a ratio of 2·77 : 1. The output turbine pressure ratio is 1·83, and the thermal efficiency of the heat exchanger is 75 per cent. The speed of the high-pressure turbine and compressors is 4500 r.p.m., and that of the output turbine 308 r.p.m., the geared down main shaft running at 85 r.p.m. Dr. Brown remarks that a set with components of the same size could now be made to develop 7000 s.h.p. by adopting supercharging and working with a cycle having twice the present ratio, the additional supercharging compressor and the turbine being small in size.

Pametrada has also in hand a 2000 h.p. gas turbine set to drive one of the compressors in the research station now under construction by Vickers-Armstrongs, Ltd. This particular turbine is of the impulse type and is fitted with nozzle control, so that it will operate under the wide load variation needed for the various researches.

RUSTON AND HORNSBY, LTD.

A new firm to enter the field of gas turbine design was Ruston and Hornsby, Ltd., of Lincoln. During the past year that firm has had designed and constructed a gas turbine plant which is now approaching completion, and will, it is expected, make its first trial runs in the early spring of this year. The prototype turbine will be coupled to an alternator, and the generating set thus formed installed in the firm's own power station in the works.

The open cycle has been adopted and the arrangement incorporates an axial-flow compressor and a heat exchanger, with a mechanically independent power turbine. The designed output of the plant is 1100 b.h.p. at the power turbine shaft, and the general compactness of the design, will, it is believed, make it attractive for many applications, including traction, transportable power generating sets and marine propulsion.

W. H. ALLEN, SONS AND CO., LTD.

Shortly before the end of the year it was announced that an agreement had been concluded between W. H. Allen, Sons and Co., Ltd., of Bedford, and the Bristol Aeroplane Company, Ltd., of Bristol, for collaboration between the two firms on the application of gas turbines for marine and auxiliary purposes, and in the industrial field. The agreement also includes the exchange of information on aeronautical and industrial turbine problems.

(*To be continued*)

MEDWAY EXHIBITION.—A comprehensive exhibition of the industries situated in the Medway towns—Rochester, Chatham, Gillingham and Strood—is to be staged at Fort Horsted, on the outskirts of Rochester, from May 21st to 28th. Stand accommodation for 150 exhibitors has been arranged, and it is hoped that the event will result in considerable stimulus to local industry.

Marine Engineering in the Royal Navy*

A REVIEW OF PROGRESS DURING THE LAST TWENTY-FIVE YEARS

By Eng. Vice-Admiral Sir JOHN KINGCOME, K.C.B., M.I.Mech.E.†

No. I

Design Requirements

In all marine designs there are three essential requirements: reliability, economy at full power, and durability. The naval designer must, however, obtain these with minimum weight and in the minimum space, and, in addition, the design must provide good economy at all powers, endurance, and flexibility combined with simplicity in handling and maintenance.

Thus there are three main conditions where economy is important: at the peacetime cruising speed, at the war cruising speed, and at full speed, and these have to be considered in the development of the design. Owing to the over-riding importance placed on weight-saving in naval designs, as a result of the Washington Treaty, British ships have been designed for maximum efficiency at full power. By aiming for maximum efficiency at some point lower than full power, a design could be obtained which would give a better overall result as regards economy at the cruising speeds, but at some sacrifice in weight and space (Fig. 1).

Reduction in the weight of machinery is of importance to the shipbuilder, as any savings can be used for more fuel or other items of military importance, but, for the engineer-designer, weight reduction must not be carried out at the expense of reliability, and the degree to which weight-cutting can be achieved should depend on the importance of the ship considered as a military unit. Further, the margins to be allowed between the various classes of ships can only be assessed by experience and by a thorough knowledge of the types of machinery being installed.

Table I draws a comparison between the various classes of ships and shows the advances made in each class. The figures represent s.h.p. per ton of main engines and boilers.

Table I.—*Advances in Output (s.h.p.) per Ton of Main Engines and Boilers*

Capital ships	Cruisers		Destroyers
	Large	Small	
"Queen Elizabeth" (original design), 26			
"Hood," 34	"Hawkins," 39	"D" class, 48	"Vee" class, 77
"Queen Elizabeth" (conversion), 51			
Modern big ship, 60	Modern cruiser, 75		Modern destroyer, 95

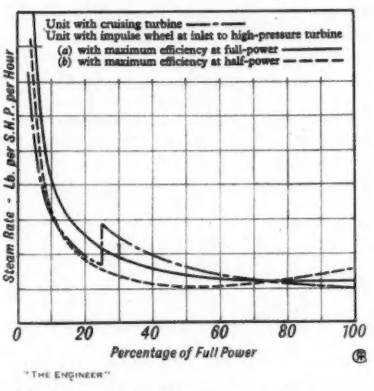
This not inconsiderable achievement was largely produced by a slow step-by-step method in which each new advance could only be tried out in the next year's new construction programme.

Steam Machinery

The basic factors in steam machinery available for variation are the pressure and temperature of the steam generated by the boilers. Raising the pressure and temperature increases the thermodynamic potential and, if advantage can be taken of it, the overall efficiency of the installation.

In 1922, British ships were using saturated steam at 220 lb per square inch, but superheated steam was being introduced in all new construction: the steam conditions in the "Nelson" class were 250 lb per square inch and 575 deg. Fah. By 1928, pressures and temperatures had risen to 300 lb per square inch and 625 deg. Fah., and it was apparent that higher temperatures would present new and unfamiliar problems. At this time, steam conditions in land plant were 330 lb per square inch and 720 deg. Fah. on average, with a maximum of 620 lb per square inch and 840 deg. Fah., and it was evident that higher steam conditions would soon be in use.

An experimental unit using steam at 500 lb per square inch and 750 deg. Fah. was installed in the destroyer "Acheron." Successful trials were carried out on completion, the fuel consumption for all purposes being 0·608 lb per s.h.p. per hour, as compared with 0·81 lb per s.h.p. per hour of her sister ships using steam at 300 lb per square inch and 625 deg. Fah. Naturally, there were teething troubles, and it was most unfortunate that "Acheron" was transferred to the Mediterranean with the rest of her flotilla. Normal duties may be the best way to find out the weaknesses in a design, but with so novel a design it would have paid to retain this ship in home waters and run her hard, but under the control of the Engineer-in-Chief of the Fleet. On the whole, the boilers and auxiliaries were fairly satisfactory, and we learnt a great deal which was of value in later designs. The high-pressure turbines gave continuous trouble, which could undoubtedly have been overcome by development testing ashore had facilities been available. Unfortunately, by this time the country was going through a financial crisis, and no money was available for the changes necessary to complete the trial.



Unit with cruising turbine
Unit with impulse wheel at inlet to high-pressure turbine :—
(a) With maximum efficiency at full power
(b) With maximum efficiency at half-power

FIG. 1—STEAM CONSUMPTION CURVES

By 1935 the war clouds were blowing up over Europe, and a policy had to be adopted in the big reconstruction programme which began in 1936. The steam conditions in land plants were by this time up to 400 lb per square inch and 750 deg. Fah. on average, with a maximum of 1800 lb per square inch and 900 deg. Fah., and it was known that certain foreign navies were using higher steam conditions; in view of our experience in "Acheron," it was decided to take no risks and to revert to our method of step-by-step advances. As a result, at the outbreak of the 1939–45 war our large ships were using steam at 400 lb per square inch and 700 deg. Fah.; destroyers were, however, still using 300 lb per square inch and 650 deg. Fah. for production and maintenance reasons; this was a complete reversal of our usual practice, which was to incorporate the more advanced designs in destroyers and only to adopt them in the bigger ships after they had been thoroughly proved under the severer conditions of the destroyer.

The "Acheron" trial was a great disappointment and stressed the need for an Admiralty research establishment and for facilities for the full-scale testing ashore of ships' machinery and equipment.

The fact that the steam conditions in British ships were lower than those in the United States and German navies has given cause for criticism, and it may be of interest to consider how the higher steam conditions were developed in the two countries respectively.

The United States Navy decided to carry out a test similar to that on "Acheron," but in a flotilla of destroyers, not just one ship. They tackled the problem differently, however; they made use of their land engineering industry, which already had experience of higher steam conditions, and set it the problem of producing a design for destroyer machinery to meet two alternative conditions: 42,000 s.h.p. with steam at 385 lb per square inch and 620 deg. Fah., or 52,000 s.h.p. with steam at 375 lb per square inch and 825 deg. Fah., both at the turbine throttle. The Navy's decision about future policy did not have to be made until 1938, by which time most of the teething troubles of the original destroyer design had been overcome. Even so, it is understood there was a good deal of discussion before these steam conditions were extended to bigger ships, but their subsequent adoption was fully justified by war experience. The item which probably contributed most to this successful development was the locked-train double-reduction gearing, which had been developed in the United States in the between-war years.

In Germany, where the trend was to use even higher pressures and temperatures, the development was carried out in merchant ships, an early example being the "Uckermark," which was fitted with a high-pressure Benson boiler as early as 1932. Further marine experience was obtained in the liners "Scharnhorst" and "Gneisenau" (650 lb per square inch and 850 deg. Fah.), and "Potsdam" (1300 lb per square inch and 875 deg. Fah.), the latter being fitted with Benson boilers. A "Narvik" class destroyer, which came to the United Kingdom after the surrender of Germany in 1945, was fitted with single-reduction geared turbines using steam at 1100 lb per square inch at 930 deg. Fah. Possibly this high pressure was used to reduce steam pipe sizes and to save machinery space; actually the machinery spaces, though very congested, were longer than in the corresponding British destroyer and the steam consumption was higher.

Towards the end of the 1939–45 war, the steam conditions in British destroyers were raised and a design was prepared using steam at 650 lb per square inch at 850 deg. Fah. For this new design, and for further work in the high-pressure, high-temperature steam field, great advances will be required in the technique of turbine detail design and manufacture, in the production of high precision gearing, in steam-valve and steam-pipe manufacture, in the development of auxiliary machinery, and in many other directions, but I feel confident that the marine engineering industry will tackle these problems with their usual skill and energy. The firms in the industry have already shown that they have appreciated their lack of research facilities and have taken the first step to rectify the position by setting up P.A.M.E.T.R.A.D.A. (Parsons and Marine Engineering Turbine Research and Development Association). This establishment includes a test house where high-powered marine sets can be tested at full power. This is a good beginning, but much research work remains to be done, not only on advanced designs, but also on production technique, without which any big step forward in the design will be hampered by the lag in production. Given the whole-hearted support of the firms themselves and of the Admiralty, there seems to be every possibility that the next decade will see a very real advance in the field of marine steam engineering.

Boilers

Advances in boiler design have undoubtedly made the major contribution to the large saving

* Twenty-first Thomas Lowe Gray Lecture, Institution of Mechanical Engineers, January 21st. Abstract.

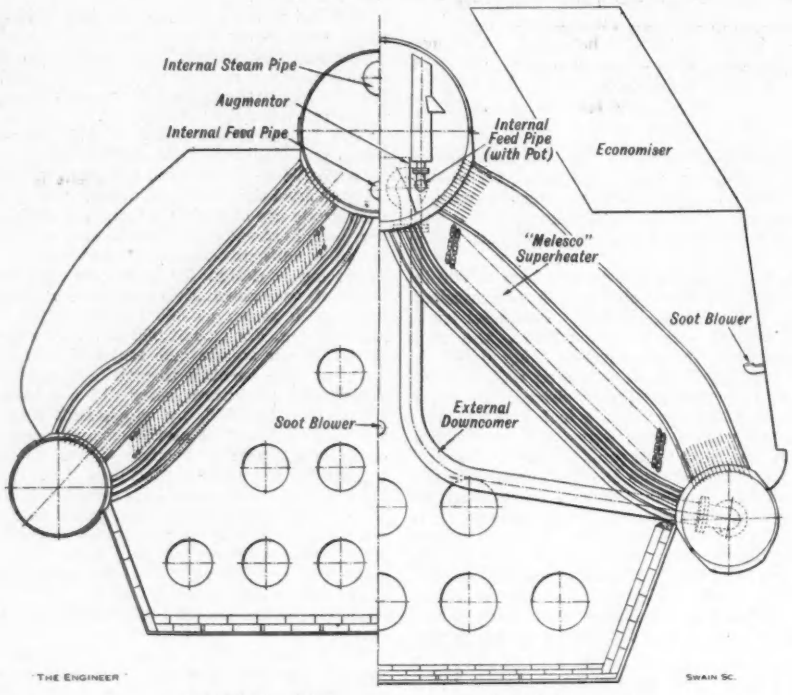
† Formerly Engineer-in-Chief of the Fleet.

in weight and space of naval machinery over the last twenty-five years. The two main reasons for these advances are that facilities have been available at the makers' works for full-scale testing of boilers, and that the Admiralty research establishment at Haslar has been able to carry out continuous research and development work on boiler designs and on the closely related subject of fuel combustion.

The priority task assigned to the A.F.E.S. on the conclusion of the 1914–18 war was the development of a superheater suitable for warships. A design was prepared with the superheater tubes behind the fourth row of generating tubes, so overcoming the disadvantages of the uptake type of superheater previously fitted. Trials of this new design were carried out in the test house at Messrs. Babcock and Wilcox works at Renfrew and were satisfactorily completed in time for superheaters of this type to be fitted in "Nelson," the first new ship of the post-war period. This type of superheater with minor modifications was fitted in subsequent ships until it was replaced by the Melesco design.

During the 1914–18 war, the oil-fired, small-tube boiler had given good service in cruisers and destroyers, but the change from coal to oil in the big ships had only taken place towards the end of the war. With this change, there was no longer any reason for retaining the large-tube boilers previously fitted in our big ships, and "Hood," completed just after the 1914–18 war, had twenty-four oil-fired, small-tube boilers for her 144,000 s.h.p., whereas "Tiger," of 108,000 s.h.p., had thirty-nine coal-fired, large-tube boilers. The resultant saving in weight and space of machinery and in personnel pointed the way to the adoption of a smaller number of larger boilers in future designs. With this end in view, much work was done at the A.F.E.S. on the development of larger oil-fuel sprayers; at the beginning of the period, the largest fuel-sprayer had an output of 900 lb per hour, but new designs with outputs up to about 1 ton per hour have since been developed. Work on improving the oil-burning arrangements continued at the A.F.E.S. throughout the period, but was intensified during the 1939–45 war, with very satisfactory results.

The development work on boilers has been mainly progressed by full-output shore trials of actual ship boilers; but, owing to the unfortunate position of the A.F.E.S. at Haslar, where the duration of trials are limited by the tide, most of these trials have been carried out at makers' works at Birkenhead, and on the Tyne and Clyde. These arrangements were not entirely satisfactory and, during the war years, an Admiralty test house was erected at Clydebank, and a number of our latest boilers have been tested there. The shortcomings of the Haslar site have now been recognised and Admiralty approval has been obtained for setting up a new and better equipped establishment on the Tyne, as soon as money and building labour are available.



On left: "Kent" class On right: Modern cruiser

FIG. 2—ADMIRALTY BOILERS

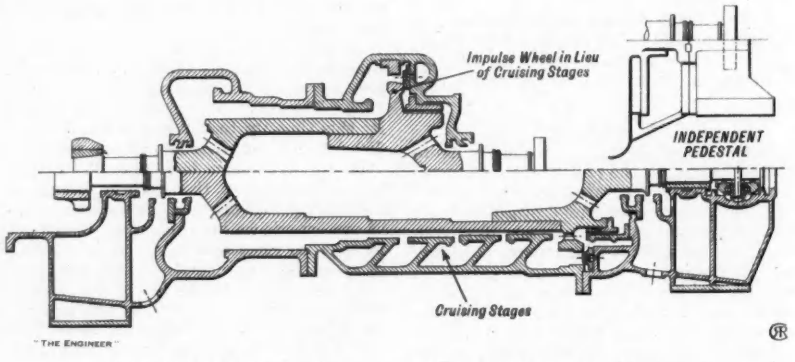
Progress in reaching higher boiler efficiencies was hampered by the ever pressing need for decreases in weight and space; for example, the addition of air preheaters and economisers would certainly have resulted in a big increase in boiler efficiencies, but only at the expense of a considerable increase in weight and space. The merits of these two items were compared and it was mainly owing to weight considerations that the air preheater was chosen. Satisfactory trials were carried out in a cruiser in 1931, and air preheaters have since been fitted in most cruisers and bigger ships; they were also fitted in a few destroyers, but space limitations are so severe in this class that their general adoption has not been possible. The fitting of air preheaters necessitated a change in the fuel-burning arrangements, with the consequent development of the "closed front" for boilers; this was so successful that it was fitted in subsequent boilers even where no air preheaters were fitted. The possible uses of economisers were always kept in mind, and with the lighter weight of the modern designs they would probably have been fitted for trial during the late nineteen-thirties but for the international situation, and the need to standardise designs when production becomes the most important requirement. Economisers have, however, been fitted on some of our latest boilers. Fig. 2 shows the development of the Admiralty boiler over this period; some of the main changes included:—

(*a*) The elimination of the straight tubes of the Yarrow design and their replacement by bent tubes, so providing a convenient space for the superheater. Attention is drawn to the curvature of the tubes: this system was adopted to save weight by reducing the number of spare tubes carried on board and is a good example of the extreme lengths to which we went to meet the requirements of the Washington Treaty.

(*b*) The deepening of the tube nest from seventeen or eighteen rows to twenty or twenty-one. The old method of assessing the forcing rate of a boiler in pounds of fuel burnt per square foot of heating surface would be sound if each row of generator tubes extracted the same amount of heat from the gases, but,

TABLE II.—*Advances in Boiler Performance*

	"Nelson"	"I" class destroyer	Modern destroyer	Modern capital ship	
				With air preheater	With economiser
Length of fire-row tube	9ft 6in	10ft 0in	11ft 8in	11ft 0in	10ft 3in
Length of furnace	8ft 9in	9ft 8in	15ft 1in	11ft 1in	10ft 3in
Evaporation from and at 212 deg. Fah., lb per hour	104,000	136,000	290,000	222,000	200,000
Fuel per square foot wall area, lb per hour	44	48	59	55	55
Fuel per cubic foot combustion chamber, lb per hour	9·2	11·6	12·6	12·7	11·6
Fuel per square foot of:					
(*a*) Generating heating surface, lb per hour	1·18	1·34	1·4	1·6	1·6
(*b*) Total heating surface, lb per hour	1·02	1·14	1·26	0·74	0·71
Efficiency, per cent	73	78	75	80	85
Evaporation from and at 212 deg. Fah. per lb of boiler weight, lb per hour	0·92	1·34	1·64	1·74	1·24



Bottom half: "Kent" class Top half: Modern cruiser of same power

FIG. 3—HIGH PRESSURE TURBINES

with fire rows taking so much more than the outer rows, it could be misleading. By adding some additional rows at the back of the nest and retaining the same forcing rate on the old basis, we should be subjecting the fire rows to a much higher loading. As the fire-row tubes are the most heavily loaded in the boiler, a new forcing-rate figure was evolved: pounds of fuel per square foot of tube-wall area, i.e., the flat area of the tube nest exposed to the radiant heat of the furnace.

(*c*) The change in tube bores from 1¼in to 1⅛in for the fire-row tubes and from 1¼in to 1in for the tubes outside the superheater. The former change was necessitated by the higher forcing rates and longer fire-row tubes of the modern boiler; the latter was made with the object of increasing efficiency without any appreciable increase in weight.

(*d*) The increase of the steam drum diameter from 50in to 56in to give adequate tube-plate arc for the increased number of rows of tubes. This change had the added advantages of providing a greater water-line area and a larger steam space.

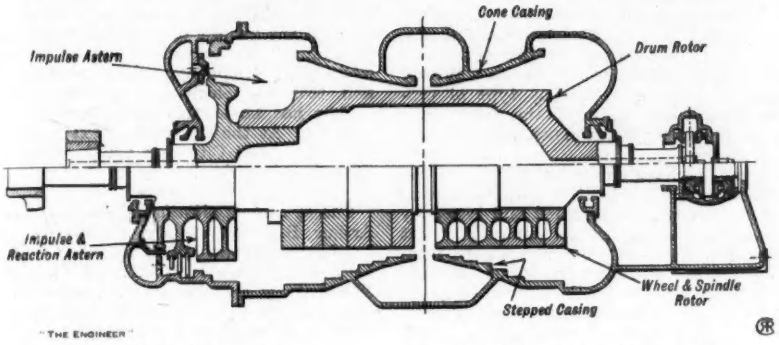
(*e*) The adoption of feed augmentors to improve the circulation. These were developed at Haslar and they tided us over the first increases in forcing rates.

(*f*) The adoption of external downcomers to ensure circulation at the higher forcing rates.

(*g*) The fitting of two internal feed pipes, with pots. The two pipes were necessitated by the use of augmentors, but their adoption was followed by hunting in the water level in the boilers (Hillier, 1947). This trouble was cured by the fitting of pots.

(*h*) The use of welded or forged drums instead of riveted drums. All-forged drums were used in the "Acheron's" boilers with the pressure of 500 lb per square inch; forged drums with riveted ends were used for lower pressures (300–400 lb per square inch), but, with the advance in welding technique, the present practice is to use riveted drums up to 300 lb per square inch and welded drums for higher pressures.

The advances resulting from these changes in the pressure parts of the boiler are shown in Table II.



Bottom half: "Kent" class — Top half: Modern cruiser of same power

FIG. 4—LOW PRESSURE TURBINES

TURBINES

At the end of the 1914–18 war, we were fitting both Parsons and Brown Curtis turbines (for convenience I will refer to these as reaction and impulse respectively), with a preference towards the latter, and impulse turbines were fitted in the first four ships of the post-war programme. Unfortunately, serious blade failures occurred, some due to blade vibration and some to wheel flap. In consequence, opinion swung over to the reaction type, and these have been fitted in all subsequent ships with a few exceptions. The relative merits of the two types have again come up for consideration in connection with our latest destroyer design, and it has been decided to fit three different designs in order to get direct service experience in both types; these are:—

(1) With reaction high-pressure and low-pressure turbines.

(2) With impulse high-pressure and reaction low-pressure turbines, and

(3) With impulse high-pressure and low-pressure turbines.

Turbines have generally been designed for maximum efficiency at or about full power, and special arrangements have had to be made to meet the requirements of economy at the peace and war cruising speeds. In some ships, separate cruising turbines have been fitted, coupled either direct or through gearing to the high-pressure turbines. Quite apart from the additional weight and space involved, these entail additional and undesirable complications in pipe arrangements and in operation; moreover, if operational requirements call for speeds just above the range given by the cruising turbines, they become redundant, and the main turbines have to be used under unfavourable conditions as regards economy (Fig. 1). In other ships, cruising stages have been fitted in the high-pressure turbines; these were not very satisfactory as there was a tendency for overheating to occur owing to the lack of steam flow under high-power steaming conditions. Probably the simplest arrangement is the provision of an impulse wheel at the inlet end of the high-pressure turbine with groups of nozzles controlled by valves, as fitted in the latest designs; but efficient operation is dependent on the manual opening and closing of the nozzle group control valves in order to maintain the minimum number of nozzles in use for the power required. Unfortunately, there was a tendency to keep more valves open than necessary with consequent loss of efficiency, and, in order to overcome this human weakness, the United States Navy method of operating all nozzle group control valves in sequence by the movement of the main manœuvring valve is being adopted in the latest designs.

Although the blading in the impulse wheels is of 39-ton austenitic steel, several failures have occurred; it has been established that the failures are due to vibratory stresses set up by resonance of the blade in its fundamental natural frequency with the frequency of the steam impulses from the nozzle jets. Once the cause of the failure was known, it was relatively easy to take the necessary corrective measures. Inaccuracies in the assembly of the earlier cast-in nozzle plates complicated the problem and accurately machined nozzle-plate assemblies are now being fitted. Very little other mechanical trouble has been experienced with turbine blading, but under war conditions there were some corrosive troubles with stainless iron blading in the low-pressure turbines of some destroyers; as no such trouble was experienced in the larger ships, the corrosion was probably caused by priming of the boiler, resulting from salt water contamination of the feed.

Although there have been no outstanding changes, various detail improvements have been made in turbine design either to improve efficiency (by the use of end-tightened blading in the high-pressure turbine), or to simplify production (by the use of side-locked segmental blading instead of the original individual blades and packing pieces), or to meet the requirements of rising temperatures (by the adoption of stainless iron or monel blades instead of bronze), or to overcome specific defects.

Figs. 3 and 4 give a comparison between the turbines of a "Kent" class cruiser and a modern cruiser turbine unit of the same power. The high-pressure turbine-bearing pedestals were originally cast integral with the bottom-half turbine casing, but with rising steam temperatures, cocking of the turbine feet occurred: separate pedestals are now fitted, secured to the turbine castings by bolts in clearance holes; alignment is maintained by horizontal keys near the horizontal joint, and a vertical key at the centre line near the bottom of the pedestal.

The higher steam temperatures also raised a problem in connection with the astern turbines, which, as shown in Fig. 4, are fitted at one end of the low-pressure turbine casings. Under prolonged astern steaming, overheating occurred in the ahead blading of the low-pressure turbine, owing to some of the exhaust steam from the astern turbine passing through both flows of the ahead turbine blading to the exhaust annulus at the far end of the turbine. This difficulty can be overcome in new designs by fitting astern turbines at both ends of the low-pressure casing, but to overcome the difficulty in existing ships desuperheaters had sometimes to be fitted on the astern steam supply.

War experience proved the weakness of cast iron to shock, and quite early in the 1939–45 war we were faced with the problem of changing all designs with cast-iron turbine casings. A change to cast steel was not possible, as the steel foundries could not possibly have met so large a demand. Welding appeared to offer the only solution, although at that time there were not enough firms in the country with sufficient welding experience to meet all the requirements, nor was there much knowledge on the design of such large welded structures. Requirements were finally met by using cast steel high-pressure and astern turbine casings and welded low-pressure turbine casings. The number of defects in steel castings was rather disturbing, and although many defective castings were saved by the use of radiological examination and welding, it is evident that casting designs must be simplified and foundry control and technique improved if such defects are to be avoided.

The effect of the various changes in turbine design on weight and space are shown in Table III.

TABLE III.—*Advances in Turbine Design*

	High pressure		Low pressure	
	"Kent" class	Modern cruiser	"Kent" class	Modern cruiser
Length between bearings	10ft 11in	8ft 6in	12ft 3in	11ft 3in
Speed, r.p.m. ...	3000	3474	2100	2446
Weight of turbine, tons ...	13½	10	30½	25

Correct operation of the turbine glands, which is essential for efficient operation, entails much work for the engine-room watchkeepers in warships, where changes of speed are frequently made. The operation has, however, been greatly simplified by the adoption of the "pot" system; suitably sized pipes are led from each turbine gland to a pot reservoir, which is fitted with a steam supply and a leak-off to condenser; by manipulation of the control valves on these two leads, one watchkeeper can maintain a pressure of about ½ lb per square inch in the pot and so pack all glands. This system has worked well, but there is still some steam leakage into the engine-rooms, which adds to the heat in these spaces. To improve the habitability of the engine-rooms, which in the tropics become uncomfortably hot, the latest practice is to fit a gland evacuation system, small steam ejectors being fitted to the outer gland pockets, whilst the pot system packs the inner gland pockets, the pressure in the pot being raised to about 3 lb or 4 lb per square inch.

(*To be continued*)

Standardisation and the Society of British Aircraft Constructors

WHILE the Society of British Aircraft Constructors plays its part in the standardisation sponsored by the British Standards Institution, who are primarily interested in issuing specifications for materials, it initiated some eleven years ago a considerable programme of standardisation work within the aircraft and aero-engine industries. Apart from the standardisation of actual components and equipment, it has endeavoured to standardise techniques which are used by aeronautical specialists for making performance and other measurements.

The Society first gave attention to the subject in 1938. In preparing the standards the society was aware of the essential need of support from designers if they were to be a success, and that has remained a keynote of the Society's standardisation activities. The use of S.B.A.C. standard parts is called for by the Ministry of Supply in the aircraft which it purchases and Ministry of Supply representatives serve on the S.B.A.C. committees responsible for introducing the designs, but the industry has complete freedom in deciding the items which will be standardised and the form which the standard items will take.

Another principle which the Society has always followed is that no design is included in its standard range unless it has the full support of all interested members. This procedure is not always followed in other countries. For instance, the main standardisation authority in America adopts the reverse procedure of publishing a standard design produced by only a few selected technicians. Experience is left to show whether the part becomes established and is used by American aircraft constructors. If, after a period of time, an enquiry shows that a particular standard part has not been popular, it is withdrawn. Those which have been adopted are retained as standards.

The United Kingdom is in a very favourable position to pursue its standardisation programme. It is possible, on account of geographical circumstances, to call together designers, without undue loss of time. In America, with 3000 miles between the west coast and the east coast, frequent meetings are impracticable. Taking advantage of this fact, the Society holds regular monthly meetings, and has done so since 1939, to which all aircraft designing companies send representatives. Similar meetings, but at less frequent intervals, are arranged when matters concerning aero-engines, propellers, hydraulics and electrics are discussed. Each member in turn accepts responsibility for developing to the project stage a new standard, which is then circulated for study to the full committee. The preliminary design is further discussed at subsequent meetings until a final version of the standard, acceptable to all concerned, is arrived at. This procedure has been successfully employed in producing nearly 6000 standard parts. In almost every case the Society has been able to arrange for the manufacture of the standard parts, and the Standards Handbooks, in which drawings are published, schedule the names and addresses of suppliers and give delivery times against prototype and production requirements. The success of this work can be estimated by the fact that the S.B.A.C. range of standards has permitted individual companies to dispense almost entirely with the extensive ranges of company standards which each previously maintained.

One innovation which has worked well is the scheme whereby the Society itself purchases moulding dies for the production of standard parts in plastic materials. As soon as the products from the moulding tools are approved, members are free to purchase bulk supplies of the parts, the price including a small oncost as a contribution towards the tool charges. The income derived from these oncosts is held against the purchase of future tools for moulding new standard parts.

The standard designs range from such small parts as rivets and washers, up to complicated components, such as complete pilots' seats, seat-raising gears, rudder bars and trim-control units. Apart from proprietary designs intended for special purposes, every aircraft rivet which is produced in this country at the present time is to an S.B.A.C. standard.

A standardisation project which merits special mention is the S.B.A.C. standard wiring system. This system comprises a range of electrical components which gives to designers complete flexibility in building up a wiring system to meet particular requirements. It introduced to the aircraft industry a method of crimping end fittings to aircraft cables which has now superseded the previous practice of soldering, and has eradicated the drawbacks of the earlier process.

Another important standardisation project is the scheme for propeller hubs and shafts, by which all manufacture in this country is controlled. The standards in this class already provide for the contra-rotating type of propeller in all sizes to meet the horsepower range of engines at present in use, and envisaged for the future.

Although perhaps only on the fringe of the standardisation field, mention should be made of the two handbooks prepared and issued by the Society, covering weight data. The first of these handbooks sets out in standard form the weights and specific gravities of the wide field of materials used by the aircraft designer. The second gives the weights of commonly-used aircraft parts and components. Both these handbooks are in general use by the weight engineers in the industry.

An S.B.A.C. standard drawing office system has also been evolved and made available to all companies in the industry. One advantage of the adoption of a standard system is in removing the problems met with in the past by sub-contractors and authorities who handle drawings prepared by a number of aircraft constructors to widely varying schemes. Interchange of draughtsmen between the drawing offices in the industry is also assisted by the use of a common system. This work followed the establishment by the Society of the most suitable form of full-scale lay-out reproduction (lofting) to meet the needs of the aircraft designer. After reviewing all the available methods of full-scale template reproduction, the Society issued a complete statement to the industry and proceeded to design and arrange for the production of the fundamental equipment required in the establishment of an aircraft loft department.

Although it has been stated that material standardisation is largely the responsibility of the B.S.I., the Society undertakes much preliminary investigation in its own materials committees so that proposals before the British Standards Institution can be said to be largely acceptable to both the manufacturers and users of the materials concerned.

Literature

SHORT NOTICES

Magnetic Control of Industrial Motors. By G. W. Heumann. New York: John Wiley and Sons, Inc. London: Chapman and Hall, 37, Essex Street, W.C.2. Price 45s. net.—Single-phase motors and commutator a.c. motors are, by implication, excluded from the scope of this book, since they are not frequently used in general industrial drives. With this limitation, the book contains an exhaustive account of electro-magnetic methods of control and only brief reference is made to electronic devices which are commonly used in conjunction with electro-magnetic control. Throughout the text the emphasis is on the application rather than the design aspect of motor control. Nevertheless, the treatment of the subject is sufficiently comprehensive to include introductory chapters explaining the performance characteristics of motors and control devices, followed by detailed discussion of the functions of commonly used control circuits. There is a separate chapter on amplidyne control circuits which are assuming growing importance. Controllers for general purposes and for intermittent duty are dealt with at some length. A good deal of space is devoted to accessories, components and pilot devices, with illustrations from American practice, and the book concludes with a chapter on the maintenance of control equipment.

Elementary Communications Practice. By W. T. Perkins. London: George Newnes, Ltd., Tower House, Southampton Street, W.C.2. Price 12s. 6d. net.—Rearrangement of the syllabus of the City and Guilds of London Institute Telecommunications Examination provides justification for a book written to appeal specifically to examination students. The book under review is designed to cover the Elementary Telecommunications syllabus, which aims to give the student a broader outlook on the subject of telecommunications by providing a groundwork in certain aspects of telegraphy, telephony, radio communication and technical electricity. Accordingly, the author has based this book on a course of lectures. At the end of the text is reprinted the first (1947) City and Guilds examination paper in this subject.

Theory and Application of Microwaves. By Arthur B. Bronwell and Robert E. Beam. London: McGraw-Hill Publishing Company, Ltd., Aldwych House, W.C.2. Price 6 dollars.—This book is an outcome of courses given to senior and first-year graduate students in electrical engineering at Northwestern University, U.S.A. It presents the basic theory of microwave systems, starting with concepts which are fundamental to all electromagnetic phenomena. The text falls into three broad divisions: first, basic electronic concepts and their application in the analysis of microwave tubes; secondly, transmission lines and networks; and thirdly, electromagnetic field equations and their use in the study of wave propagation, reflection phenomena, wave guides and radiating systems. Wherever possible, the analytical results are expressed in a form convenient for engineering use, and the engineering viewpoint is emphasised throughout the book. Generally, a knowledge of radio circuit theory and calculus is required for an understanding of the analytical parts of the text.

BOOKS RECEIVED

Year Book of the Heating and Ventilating Industry. London: Technitrade Journals, Ltd., 8, Southampton Row, W.C.1. Price 5s.

Electric Winders. Second edition. By H. H. Broughton. London: E. and F. N. Spon, Ltd., 57, Haymarket, S.W.1. Price 63s.

Timber Engineers' Handbook. By Howard J. Hansen. London: Chapman and Hall, Ltd., 37, Essex Street, W.C.2. Price 60s.

Report on Drawing Office Organisation. London: O. W. Roskill and Co. (Reports), Ltd., 14, Great College Street, S.W.1. Price 30s.

Telephony. Vol. I. By J. Atkinson. London: Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, W.C.2. Price 35s.

Process Engineering. By William H. Schutt. London: McGraw-Hill Publishing Company, Ltd., Aldwych House, W.C.2. Price 24s.

Notes on Soldering. By W. R. Lewis. Middlesex: Tin Research Institute, Fraser Road, Greenford, Middlesex. Issued free of charge.

Problems in Electrical Engineering. By S. Parker Smith. London: Constable and Co., Ltd., 10, Orange Street, W.C.2. Price 10s.

Theoretical Structural Metallurgy. By A. H. Cottrell. London: Edward Arnold and Co., 41 and 43, Maddox Street, W.1. Price 21s.

Production Engineering. By J. S. Murphy. London: Iliffe and Sons, Ltd., Dorset House, Stamford Street, S.E.1. Price 12s. 6d.

Symposium on Internal Stresses in Metals and Alloys. London: The Institute of Metals, 4, Grosvenor Gardens, S.W.1. Price 42s.

Asbestos: Its Preparation and Application. By A. E. Williams. London: Emmott and Co., Ltd., 21, Bedford Street, W.C.2. Price 2s. 6d.

Soil Erosion, Its Prevention and Control. Madras: Government of Madras, Development Department, Fort St. George, Madras. Price 6 rupees.

Modern Timber Design. By Howard J. Hansen. Second edition. London: Chapman and Hall, Ltd., 37, Essex Street, W.C.2. Price 27s.

Industrial Photocells

After considerable research and development work, Mullard Electronic Products, Ltd., Century House, Shaftesbury Avenue, London, W.C.2, has recently introduced a new range of photocells designed to fulfil special requirements for industrial application. These requirements include robustness, rigidity, reliability and long life; maximum permissible cathode current and high sensitivity.

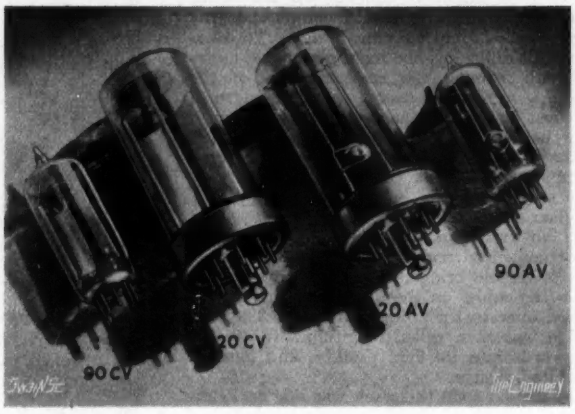
The photocells at present available in the new range fall into two main groups: the first having a high sensitivity to incandescent and infra-red light, and the second having a particularly high sensitivity to daylight and blue light.

Every unit in this new range is of all-glass construction, which provides the maximum possible cathode area, at the same time ensuring a high degree of rigidity and freedom from microphony. As illustrated herewith, the photocells are available in two sizes, the large "20" series on a loctal base and the "90" (miniature) series on a button "B7G" base. This standardisation of bases should do much to simplify the design of industrial electronic equipment using photocells. Both sizes give the maximum cathode surface/size ratio. The miniature photocells give adequate output current for a great number of applications and are particularly suitable for those equipments in which conservation of space is an important factor. The loctal base photocells have a higher output by reason of their larger cathode area, which renders them particularly suitable for use in standard industrial electronic control equipments.

In the first group of photocells (20CV, 90CV, 20CG and 90CG) high sensitivity to infra-red and incandescent light results from the use of caesium (C) cathodes. The 20CV photocell has a sensitivity of 25 microamperes per lumen and the maximum permissible cathode current is 20 microamperes. The 90CV photocell has a sensitivity of 20 microamperes per lumen, the maximum permissible cathode current being 10 microamperes. Photocells 20CG and 90CG are gas-filled versions.

In the second group the types 20AV and 90AV are caesium-antimony photocells and have been specifically developed for applications demanding the highest possible sensitivity to daylight and blue light. The total sensitivity to daylight of these cells is approximately forty times greater than that of photocells having "C" type cathodes. The sensitivity to incandescent light of these cells is also very high—approximately 45 microamperes per lumen—but their response to infra-red is negligible. The dark current of both cells is very low.

These characteristics make the cells of particular value for light quality measurements, colour matching applications, and daylight controls, such as street lamp switches.



RANGE OF INDUSTRIAL PHOTOCELLS

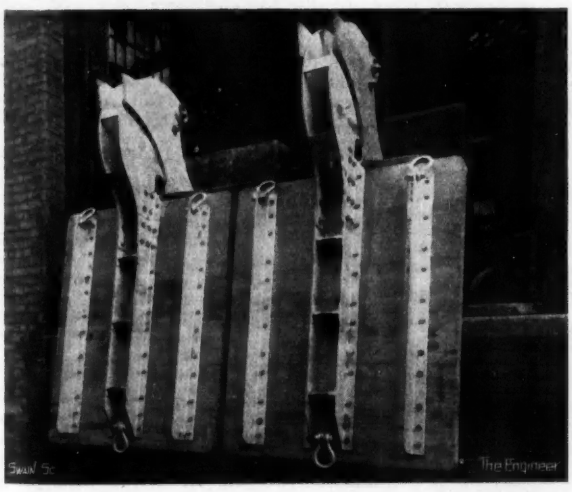
A Tidal Flap Valve

On previous occasions we have described some of the interesting applications which have been made of tidal flap valves made to the designs of the Ismailia Valve Company, Ltd., of 17, Victoria Street, London, S.W.1. In the photograph we reproduce below can be seen, at the maker's works, a set of these valves, which has been specially designed and constructed for installation at the entrance to a culvert in a sea wall in Ireland. This wall protects some 900 acres of arable land from the sea at Blanket Nook, Lough Swilly. The culvert is some 11ft wide and 9ft high and its reinforced concrete entrance has two openings, 5ft 9in by 4ft 8in, which are closed by the new 6ft 3in by 5ft 6in flaps. During the spring tides there is a head of water of some 22ft above the valves.

The valve mechanism is based upon the same principle as previous designs, there being no hinges to bind, corrode or wear. The doors or flaps are supported on centrally-disposed overhead guides, on which they are arranged to swing freely. During movement of the flaps the convex surface of one support bearing rides upon the convex surface of another over a relatively short arc, to permit a flap opening sufficient to pass the maximum quantity of water which can flow from the culvert. These support bearings are heavy tubular brass castings, on which the wear in service is stated to be negligible.

Heavy galvanised fabricated pedestals supporting each of the guides are rigidly bolted to a sill situated over the concrete culvert entrance. Extensions to steel straps on the flaps register in the guides, with the bearings in contact and in alignment.

Owing to the high cost and difficulties encountered in obtaining cast iron, the flaps of these valves have been built up from planks of 4in thick greenheart timber, rigidly bolted together and reinforced by fabricated galvanised steel straps. Greenheart timber, as is generally known, sinks in water, and its durability for this class of work has been long recognised. In their normal closed position the flaps rest squarely on the concrete round the culvert entrance and provide an effective seal, which has rendered unnecessary, in this case, the use of additional sealing medium, such as the rubber strips usually fitted to make them watertight. The watertight properties of this type of flap valve are stressed by the makers, as this feature avoids the possibility of scoring on the seating face, which can be caused by any back-flow of sea water carrying sand and grit.

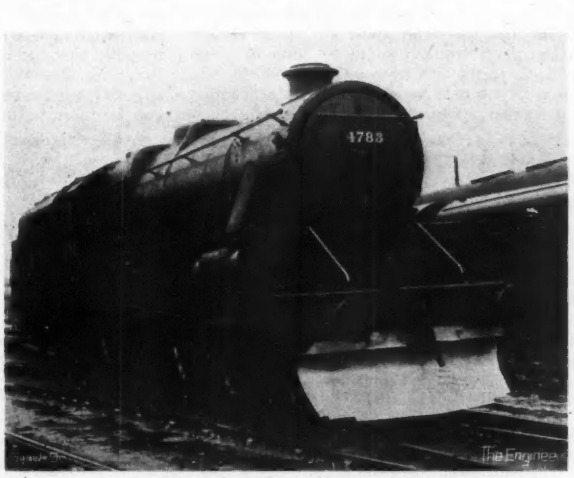


FLAP VALVE

Snow Ploughs for British Railways

After the very severe winter of 1947, careful consideration was given by the former L.M.S. railway to the whole problem of dealing with snow and ice on railways. A committee was formed to consider every aspect of the problem and make recommendations as to the steps which should be taken to deal with severe winter conditions in the light of the experience gained. The whole of the snow-ploughing equipment was reviewed, and it was recommended that three new types of ploughs should be designed and constructed in adequate quantities to cover the whole of the company's system.

It was decided that the most important requirement was for a small plough, which could be fitted under the buffer beam of certain classes of powerful locomotives to enable these engines to run through small drifts of snow, either whilst hauling their normal trains, or when patrolling as light engines. By this means it was considered that it would be possible, in general, to prevent the building-



SNOW PLOUGH

up of snow drifts which, under bad conditions, cause a complete blockage if traffic ceases.

The principal danger area on what is now the L.M. Region of British Railways was considered to be the Leeds-Carlisle main line, which crosses the Pennines over what is known as Ais Gill, and for this section, seventy-six locomotives of the 2–8–0, 4–6–0 and 2–6–0-wheel arrangements have been, or are about to be, fitted with a small type of plough. The plough, as can be seen from the photograph we reproduce, does not extend beyond the buffers, and therefore does not restrict the engine's operation in any way. Ploughs can therefore be placed in position on selected locomotives at the beginning of the winter and remain there until spring.

For the occasions when these preventive methods fail and a deep snowdrift is formed, it is necessary to resort to ploughing with large ploughs capable of cutting through drifts up to 12ft in depth. Two new designs of such ploughs have been recommended, a larger type which reaches to the top of the smokebox and another, of an intermediate size, for less severe conditions. Both types are of fabricated steel construction, designed for fitting to the front of locomotives of the standard "Class 4F" 0–6–0 type. The designs have been completed and we are informed that the first prototype plough of the larger type has been built.

Renewal of a London Railway Bridge

We have received particulars of an interesting bridge-renewal operation recently completed on the London Transport railway system, on the Hammersmith and City line. In this operation a new double-track bridge was rolled into position over St. Marks Road, at the west end of Ladbroke Grove Station, to replace an eighty-year-old structure of wrought iron with a timber deck.

In order to minimise interruption to railway traffic the work was planned so that the old structure was removed, the new bridge rolled into position, and all track work reconnected in the course of a single day's occupation. To make this possible, the new bridge, complete with ballast, sleepers and chairs, was erected on temporary steel staging north of the existing span, as shown in the illustration below.

The new bridge has an overall width of 29ft 9in and its three main 46ft long girders and the deck contain some 43 tons of steel. The deck joists are encased in concrete and covered by asphalt and tiles, the waterproofing being carried up to rail level against the main girder webs. The total weight of the complete bridge when ready for rolling in position was about 165 tons.

The space available for constructing the new bridge on a temporary staging was restricted by the proximity of a house on the west side of the road. This obstruction necessitated the rolling in of the new bridge to be effected in two stages—by a lateral movement of 32ft and a longitudinal movement of 4ft 6in, to bring the new structure into its final position.

The presence of a building on the south side of the railway similarly complicated the removal of the old existing bridge. To overcome this difficulty, the main girder and cross-members forming the northern half of the bridge were first cut away. A short length of the west end of the main girder on the south side was then cut away and the remaining half of the bridge rolled laterally clear of the final alignment of the new bridge on to temporary steel staging already in position.

When the northern half of the old span had been cut away the rolling in of the new structure commenced, and as it reached the remaining part of the old bridge, both travelled together, while the cables on the old centre girder were passed over to their new positions. The new bridge was then rolled longitudinally 4ft 6in westwards into its final position and lowered on to its bearings.

On the old span the track was laid on longitudinal timbers, a practice no longer favoured owing to maintenance difficulties. The tracks over the new span are fully ballasted and, as the new rail level was 7in higher than previously, the permanent way at each end of the bridge had to be raised.

The main contractor for this work was Joseph Westwood and Co., Ltd., and the sub-contractors for the erection of the bridge were Messrs. Askham and Palin.

New Bridge on Temporary Supports

A Bench Grinding Machine

The photograph we reproduce shows a useful little bench grinding machine particularly intended for machine shops where a special tool and cutter grinder is not always justified. Its design is such that it can be used for single-point cutting-tool grinding, chip-groove grinding or surface grinding, and, by using centres which are supplied, for sharpening milling cutters, reamers, &c.

The spindle head has an adjustment of 20 deg. in each direction, and this feature, combined with the swivelling table, makes it possible to grind a wide range of angles, rakes, &c., with the use of a universal vice. Standard wheels from 3in to 6in in diameter by 1¼in bore can be mounted directly on the spindle, or on either of two adaptors, which extend the spindle 5⅛in and 7⅛in respectively. The spindle runs at 2850 r.p.m.

The table of the machine is 17in long by 5in wide a 17in by 3in swivelling table being provided as standard equipment. The table has a vertical adjustment of 5¼in, and a transverse movement of 9¼in, which can be operated quickly or slowly through independent levers. To facilitate setting, micro-scales are fitted on all handwheels.

"Neven" Bench Grinder

A coolant tank is housed within the base of the machine and coolant is delivered by a pump to the working point at a rate of 12 gallons an hour.

This machine, known as the "Neven G.F.3," is marketed by A. C. Wickman, Ltd., of Coventry.

Magnetic Escapements for Pendulum Clocks*

An interesting application of the magnetic properties of the nickel-iron series of alloys is the magnetic escapement for clocks recently invented by Mr. C. F. Clifford, of Horstmann-Clifford Magnetics, Ltd., and it may be of interest to examine in some detail the stages in the development of this device.

Requirements in Clock Escapements

It is generally agreed that an oscillating pendulum is an almost perfect timekeeper within certain limits of amplitude of swing. If uniform force is applied to maintain oscillation as in a clock escapement, the escape wheel should supply the impulsing forces and no others. That is to say, that the whole of the energy content of the escape wheel should find its way into the pendulum. If this can be achieved, the result is the perfect pendulum clock.

The efficiency of an escapement is thus expressed by the percentage of the escape wheel energy which enters the pendulum. Despite the high degree of precision workmanship entering into the modern clock, the highest efficiency calculated for a mechanical escapement is about 18 per cent on a one-second, hand-wound pendulum clock, while most have escapement efficiencies of approximately 10 per cent, the remainder of the energy being dissipated in friction, including losses in the escape mechanism.

The magnetic escapement on a one-second pendulum achieves an efficiency of 40 to 60 per cent and on very short pendulums 15 to 50 per cent, as compared with 1 to 9 per cent.

* *Mond Nickel Bulletin*, October, 1948. Abstract of Lecture by Mr. C. F. Clifford, read to the British Horological Institute.

with the mechanical escapement. This great improvement is largely the result of there being no mechanical contact between the escape wheel and oscillator, and therefore no friction, no impact, no wear and no noise.

Development of the Magnetic Escapement

The development of the magnetic escapement is illustrated in Figs. 1, 2 and 3. The first stage (Fig. 1(*a*)) has a sine-wave of magnetic material not quite touching the magnet, attached to the pendulum, which traverses exactly over the sine-wave as the latter is moved forward. The oscillation of the pendulum regulates the speed at which the sine-wave will progress under light torque and at the same time the energy resultant from the field between the magnet and the sine-wave maintains the oscillation.

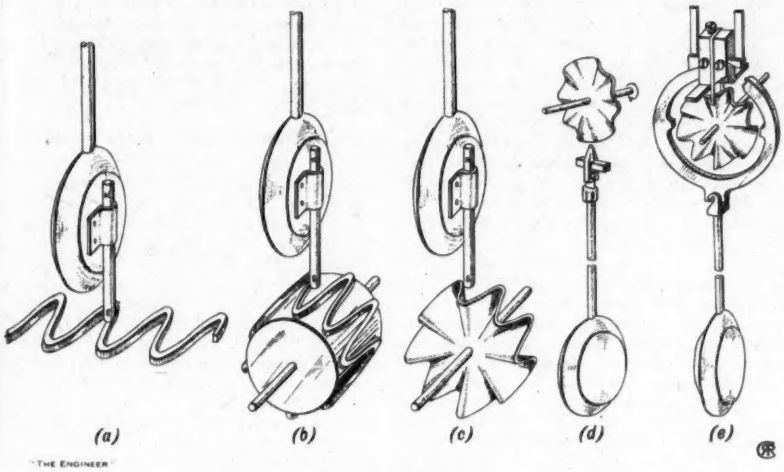


FIG. 1—*Sine-Wave Principle of Magnetic Escapement.*

Fig. 1(*b*) shows the next step where the sine-wave is wrapped round a cylinder and rotated by a shaft, which can only turn at the speed dictated by the pendulum and its magnet. This form is, naturally, an expensive one to manufacture and one solution is shown in Fig. 1(*c*), where the sine-wave takes the form of a disc with a crinkled edge. The disadvantage here is that there is a limit to the depth of the crinkles, and the pendulum amplitude would thus be too small for practical application.

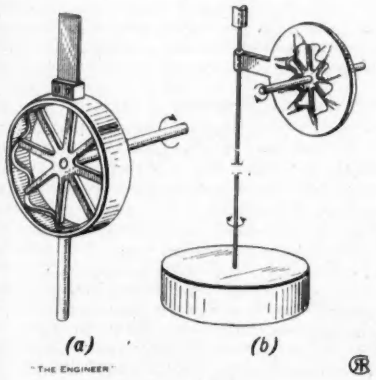


FIG. 2—*Rotating Magnets*

To ensure a large pendulum amplitude from a small controller sine-wave the design shown in Fig. 1(*d*) was evolved. Fig. 1(*e*) shows a further step, which forms the basis of a very successful design with pendulum oscillating at right angles to the plane of rotation of the wheel. The magnet here takes the form of a ring with two poles.

In all these designs the sine-wave has been the component which rotates, but Figs. 2(*a*) and 2(*b*) illustrate designs where the magnet rotates inside an oscillating sine-wave, the latter showing a torsional pendulum.

For the three-a-second pendulum, the rotating sine-wave seems preferable because of its lower weight, but on the one-second pendulum clock high efficiencies and hence good time-keeping are obtained from both methods. From Fig. 3 it will be seen that the design can utilise a sine-wave which is not continuous. In this model, magnetic pins of "Mumetal" wire are embedded in a Perspex wheel and the sine-wave in the form of extension pieces of "Mumetal" is mounted on the poles of the magnet.

Requirements of Materials

None of these models has the escape wheel touching the pendulum and it might be concluded that there are no losses. But this magnetic coupling has its own source of loss, although this is much lower than the losses usual in a mechanical escapement. A typical one-second pendulum gave the follow ng figures for dissipation of energy from the escape wheel :

	Per cent
(*a*) Eddy current loss in sine-wave	2
(*b*) Hysteresis loss in sine-wave	15
(*c*) Friction loss in escape wheel bearings	17
(*d*) Eddy and hysteresis loss in magnet	16
(*e*) Energy injected into pendulum	50
Total energy supplied by escape wheel	100

With a pendulum beating three times a second, the 2 per cent eddy current loss quoted will rise to 18 per cent. Continual research on materials will, of course, result in further reduction in such losses as (*a*) and (*b*) and perhaps (*d*). The chief properties expected in the materials are, for the magnet, a material which has high coercivity, giving rise to fluxes which can be relied upon to remain constant and, for the sine-wave, a magnetic alloy with very low loss.

For the sine-wave, "Mumetal" has been the material selected. This is a nickel-iron alloy containing approximately 76 per cent of nickel and is classed as one of the high-permeability alloys having very wide uses wherever high permeability and low losses are needed at relatively low flux densities. Alloys in th s class have good mechanical properties, and are easily rolled, enabling thin strip to be produced. They may be stamped, pressed, drawn or cast. "Permalloy," "Radiometal," and other alloys in this class can also be used for the sine-waves in the magnetic escapement.

The newer magnet alloys containing nickel and aluminium offer important advantages, particularly in cases where the size of magnet is restricted. These alloys are also exceedingly stable in service even under adverse conditions of temperature and vibration.

Other features of these alloys are those of low cost and high energy per unit volume, which means that a small quantity of material is required for a given performance.

It should be noted that the mechanical properties of these alloys are, in general, such as to preclude any possibility of machining. They can, however, be cast and finished by grinding on the pole faces. A recent innovation is the use of sintering by powder metallurgy.

In one example (Fig. 2(*a*)), "Ticonal" was the material used for the wheel, in order to give a very powerful magnet of small dimensions.

For normal use, the wooden pendulum with the improvement given by the magnetic escapement is likely to be adequate. But for high precision a rod made of a low-expansion nickel-iron alloy, such as "Invar," can be substituted.

Advantages of the Magnetic Escapement

Since only about a quarter of the main spring energy has to be supplied in a clock with a magnetic escapement, the driving mechanism can be made smaller, lighter and cheaper. Since there is no need for lubrication of the escapement and no wear, the clock should work longer between overhauls. A clock of this type is also more tolerant of out-of-level than the normal pendulum clock and time-keeping is much better than with a mechanical escapement. The best British hand-wound clocks, for instance, give a figure of about ±10 seconds a week. An equivalent one-second pendulum model with a magnetic escapement will keep time to ±2 seconds a week with a wooden pendulum rod. Low-expansion nickel-iron alloy, when substituted for the wooden rod, increases accuracy with temperature, so that the clock will follow the barometric error of 0·35 seconds per day per inch of mercury.

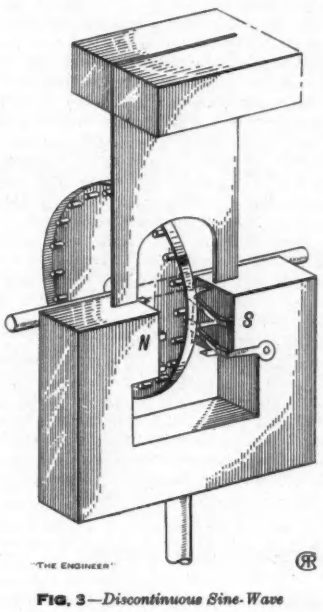


FIG. 3—*Discontinuous Sine-Wave*

Although this description has been limited to the application of the magnetic escapement to the pendulum clock, work is proceeding on its adaptation to the balance wheel and there is no doubt that within a very short time this simple escapement will assist British clock and watchmakers to develop timepieces which can compete abroad with the finest products.

The latest development, for instance, utilises a blanked magnet supported by a phosphor bronze spring stamping, of tuning-fork shape, working with a starwheel stamped from "Mumetal." The oscillation of the magnet keeps the starwheel speed constant and because of the design there is little wear, since, instead of the balance wheel oscillating, there is only the flexing of the magnet support. Since only the clearances are important, cheap construction is likely to be a feature, combined with increased efficiency and hence better time-keeping.

Industrial and Labour Notes

British Overseas Trade

In his recent review of economic progress in 1948, the Chancellor of the Exchequer intimated that exports in the month of December reached a total value of £145,700,000. The monthly accounts, published at the end of last week by the Board of Trade, show that the actual total was £145,711,107, a figure which brought the total value for the whole year to £1,583,328,704. By volume, it is estimated that exports of United Kingdom goods in December were 148 per cent of 1938, compared with 149 per cent in November. For the fourth quarter of last year the volume of exports was approximately 147 per cent of 1938. Imports in the month of December were valued at £178,669,512, and re-exports amounted to £6,429,010, so that the visible adverse balance was £26,529,395. Taking the whole of 1948, imports to this country were valued at £2,079,537,813, and re-exports at £64,535,548.

Surveying export progress over the whole of last year, the *Board of Trade Journal* says that in the first six months exports of machinery rose quickly, and that in the last two quarters there were further steady increases. In volume, machinery exports in 1948 amounted to 885,000 tons, 25 per cent more than in 1947, and nearly double the 1938 total. Agricultural tractors and textile machinery made a notable contribution to last year's achievements, and exports of prime movers were 33½ per cent higher than in 1947. Exports of electrical machinery last year were not much greater than they were in 1947, and the quantity of machine tools exported in 1948 was slightly below the 1947 total, although it was still twice as much as was exported in 1938. Vehicle exports were also another outstanding feature of the year's progress, the number of private motor cars and chassis sold overseas amounting to 227,000. Exports of commercial vehicles totalled 75,091 units, compared with 49,633 in 1947 and 15,464 in 1938. Last year's iron and steel exports increased steadily in the second and third quarters and then rose sharply during the fourth quarter, bringing the total quantity to 2,010,000 tons, or 7 per cent above the 1947 figure.

Nationalisation of Shipping

It is reported that discussions concerning proposals for nationalising the shipbuilding industry have taken place recently between representatives of the Trades Union Congress, the Confederation of Shipbuilding and Engineering Unions, and the Labour Party.

The United Society of Boilermakers and Iron and Steel Shipbuilders has put forward a case for nationalising shipbuilding, and has expressed the hope that the "principle involved" will be accepted. The Society's monthly circular says that "the shipbuilding industry is too vital to our national economy both in commerce and defence to leave in private hands, especially when monopolistic tendencies are evident. There is every indication," it is added, "that high costs and falling orders will shortly face the industry."

The circular goes on to say that the Society is not pressing for nationalisation of the ship-repairing industry as a whole "at this stage," but it suggests that where ship-repair work is at present carried on in shipbuilding yards, it should be acquired along with the yard. At the same time, the further suggestion is made that a scheme should be introduced for the decasualisation of labour in the ship-repairing industry similar to that which applies to stevedores and dockers.

Iron and Steel Nationalisation

The General Secretary of the Iron and Steel Trades Confederation, Mr. Lincoln Evans, has made some further observations, in the current issue of *Man and Metal*, on the subject of nationalising the iron and steel industry. He suggests that members of the Confederation must realise that nationalisation in itself does not mean the solution of all their difficulties, and that the purpose of the Bill is not solely to enable better conditions to be obtained. These, no doubt, will come, Mr. Evans says, in the ordinary process of negotiations, but such improvement cannot be expected as an automatic consequence of public ownership.

Commenting that a change in ownership will be no substitute for trade union action, Mr. Evans says that the first overriding obligation of the new Iron and Steel Corporation will be to the community. Its job will be to produce cheap and adequate supplies of steel and, in so far as it does that, it will succeed. "In so far as it does not," the observations continue, "it will fail and go into the dustbin of history as an experiment in industrial ownership and organisation which failed to deliver the goods."

This indicates, it is added, the great extent to which the success or otherwise of nationalisation will depend, in the last resort, upon what the workers in the industry put into it. Mr. Evans sees no reason to believe that workers in the iron and steel industry will put less into it under nationalisation than they did under private ownership, and remarks that, on the contrary, the nation is entitled to expect that they should put more into it. One of the strong arguments for nationalisation has been, according to Mr. Evans, that the workers will be inspired by entirely different motives when working for the good of the nation rather than private shareholders. So far, the comments conclude, "there is no marked evidence that this is the case, but rather, on the other hand, the administrations of industries already nationalised are frequently being blamed for something that is lacking in ourselves, in that too many workers see in public ownership only an opportunity to exploit rather than a chance to serve."

Plant Replacement and the Budget

The National Union of Manufacturers has made some proposals which it is hoped will be considered by the Chancellor of the Exchequer in framing this year's Budget. Foremost among these proposals is a suggestion concerning the replacement of plant, machinery and buildings.

On this matter, the National Union of Manufacturers says that, on the average, plant and machinery which cost £100 in 1938 now cost well over £200, but the only tax free profit available to meet such an outlay cannot be more than £100 under the present taxation rules, so that manufacturers have to find at least a further £100 out of what is left of profits after they have been reduced by the payment of income tax and profits tax at their existing high levels. In a large number of cases this means that plant replacements—as distinct from additions—can no longer be financed from retained profits, and resort has to be made to a money lender of sorts. In any rational system of taxation, it is urged, this is as undesirable as it should be unnecessary.

The National Union thinks that one method of easing this situation would be to increase substantially the existing initial allowance. This is a proposal which does not permit any concession being obtained until the replacement has actually taken place, it applies equally to extensions as well as replacements, and new entrants would benefit as well as established manufacturers, although the benefit to the manufacturer in respect of the allowance would not accrue immediately the expenditure was incurred. The recommendation is that the present allowance should be increased to 40 per cent for plant and machinery and 20 per cent for buildings.

An alternative suggestion advanced by the National Union is that existing rates of wear and tear allowances should be calculated on a figure approximating more closely to the cost of replacement, so that when the time for replacement arrives the manufacturer would have accumulated by way of wear and tear and other allowances a sum equivalent to the money needed to meet the cost. One method of doing this would be by writing up the book value of plant and buildings as at December 31, 1939, or some approximate date, and all subsequent additions and renewals, by agreed and adequate coefficients. The National Union recommends that the tax saved on any increased allowances that would be obtained under this scheme should be invested in special reserve certificates, the proceeds of which could only be used for the replacement of plant and machinery.

Production and "Thwarted Enterprise"

In a statement accompanying the annual report of the District Bank, Ltd., the chairman, Sir Thomas D. Barlow, comments on the number of people employed in unproductive activities arising out of Government control. We are told, he says, that lack of manpower holds up the production drive, yet it is clear that the abandonment of more controls would release large numbers of unproductive workers. The further removal of controls should go some way towards reviving healthy competition and business enterprise, and by raising output should help to dispose of inflation just as effectively as by curtailing the supply of ready money for spending.

Industry, Sir Thomas continues, has been addressed with two conflicting voices. It has been exhorted to increase its efficiency, but at the same time to restrict its expenditure as a means of curtailing inflation. In a period of rising prices, the consequences, Sir Thomas asserts, have been unfortunate. Liquid resources set aside for capital replacement have had to be used for the replenishment of stocks, and in the meantime costs of machinery and modernisation have risen to an abnormal degree. Furthermore, the position is aggravated by heavy taxation, whilst depreciation allowances, though materially larger than they were, are inadequate in relation to existing values. These unfavourable conditions, Sir Thomas observes, press with peculiar severity upon small and medium-sized firms which still constitute by far the greater part of the industrial community.

Sir Thomas goes on to say in his statement that the irresistible conviction which arises is that the Government is trying to do too much and too fast. It has already nationalised more than enough, and has sufficient material to consolidate without embarking upon fresh adventures. He considers that from an economic standpoint the overdeveloped Government activities, which consume so large a volume of manpower, should certainly be curtailed.

Industrial Disputes

The Prime Minister was asked in Parliament on Monday last by Mr. Walter Fletcher whether he would appoint a Royal Commission to inquire into the question of the increase in unofficial strikes, and to recommend what strengthening of trades union law was desirable. In his reply, the Prime Minister said that there had been a most satisfactory decrease in the number of working days lost through stoppages of work on account of industrial disputes, the total for 1948 being 1,944,000. That was the lowest yearly total since 1943, and compared with a total of 2,430,000 working days lost in 1947. In the circumstances, he did not consider that the appointment of a Royal Commission was either necessary or desirable.

Index of Industrial Production

The Central Statistical Office has estimated provisionally that the index number of industrial production (1946=100) was 129 for November, 1948, compared with a figure of 127 for October. For the corresponding months of 1947, the index figures were 123 and 120 respectively. An analysis of the November, 1948, figure shows that for manufacturing the index number was 132, and for mining and quarrying 119,

French Engineering News

(From our French Correspondent)

The Minister of Industrial Production has ordered the S.N.C.F. to use steam instead of electric locomotives on 16,500km daily, in order to economise in electric power consumption.

Further restrictions are also being envisaged, steam-operated power-station output having been pushed to a maximum to cover hydro-electric deficiencies. Restrictions on the S.N.C.F. are expected to save 250,000kWh. The Metropolitan railway has been asked to reduce its service and lighting load.

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French production of special steels, which now amounts to about 700,000 tons monthly, is also likely to be affected by electricity restrictions. The quantity indispensable to the country is small, about 33,000 tons of ingots monthly, but it requires 25,000,000kWh a month to produce. Every effort is being made to keep supplies normal in order to avoid unemployment in steel plants, but the allocation of electricity has been reduced 50 per cent, compared with 1948 demand. The situation is particularly grave as this type of steel production cannot be made up during summer months, owing to the restricted amount of plant in the country. It is likely that France may yet have to import special steels.

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French automobile production in 1948 was 190,000 units, against 137,377 in 1947. In 1949 it is expected that 220,000 vehicles will be produced: Renault will produce about 70,000 units, of which 36,000 will be private and 34,000 commercial vehicles. Potential of the Billancourt plant will be 135,000 a year and production will reach that maximum by the end of 1949, provided supplies of steel sheet and tyres are available. Peugeot will produce 20,000 private cars and 12,000 commercial vehicles. Production will be 205 vehicles daily in 1949, against 125 in 1948. Citroen will produce 165 vehicles daily to make a total of 34,000 private cars and 8000 commercial vehicles. Simca will produce 20,000 vehicles and from the beginning of 1949 daily production will be 110 vehicles. Ford will produce 17,000 vehicles, of which 4500 will be private cars.

There is something of a crisis in the repairs branch of the motor industry, however. Costs of maintenance are prohibitive and traffic has been much reduced by lack of petrol.

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The S.N.C.F. has now completed the most urgent of its reconstruction work and has increased its stock by 5743 trucks (2650 imported) and forty-six locomotives, including two electric locomotives. Needs are still higher than can be covered by the increase. French constructors have just completed the first of 150 fabricated carriages ordered since the Liberation. There is still a large deficit in goods trucks, the 47,000 delivered since the Liberation being insufficient to cover war losses and obsolete trucks taken out of service.

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Total French tractor production in 1948 was 15,000, and this figure will be increased in 1949. Imports amounted to 13,137 wheeled and 2265 track-laying tractors. At the moment, France has between 80,000 and 90,000 tractors in use, of which almost half are less than four years old. The objective is 250,000 by 1952. In 1949 France will receive 15,000 tractors as part of Marshall Aid.

* * *

Following the liaison established between the Forges et Aciéries du Nord et de L'Est and the Aciéries Denain-Anzin, by the constitution of the Société Usinor, modernisation and rationalisation of the French steel industry has been continued by the creation of a new firm—the Société Lorraine de Laminage Continu (Sollac)—under the ægis of the firms Wendel, Aciéries de la Marine et d'Homécourt, Hagondange, &c. The promoters of tne new firm are now negotiating the purchase of rolling mills to the value of 40 million dollars from the United States. The new rolling mills will be able to supply between 400,000 and 800,000 tons of plate a year.

Notes and Memoranda

Air and Water

STOCKHOLM'S FLOATING DOCK.—A new floating dock, capable of lifting vessels of up to 16,000 tons, has now been put into service at the Finnboda shipyard, Stockholm. The new dock, which has a length over the pontoons of 478ft, a free width between the walls of 78ft, a depth over the keel-blocks of 23ft, and a lifting capacity of 8500 tons, was built in record time by the Furness Shipbuilding Company, Ltd., and transported to Stockholm in seven sections by Dutch ocean tugs.

SWEDISH AIRCRAFT ACCIDENT REPORT.—The report of the investigation into the cause of the accident to the Swedish airliner at Northolt on July 4, 1948, has been published by H.M. Stationery Office (price 6d.). It will be recalled that the airliner collided with a "York" aircraft operated by the Transport Command of the R.A.F. The report says that, though the evidence did not establish affirmatively the actual cause of loss, it was in all probability to be found in the field of human fallibility on the part of those responsible for the control of the aircraft from the ground or the flight of the aircraft in the air.

HYDRO-ELECTRIC SCHEME FOR SOUTHERN CHINA.—It is reported that work is likely to begin shortly on a large-scale hydro-electric scheme in the Wong Kiang area of Southern China, which is aimed at speeding up the industrial expansion of Northern Kwantung and opening the way to the development of the rich mineral resources of the province. Plans have also been drawn up to build, in conjunction with the scheme, a series of dykes to control summer flood waters which inundate southern areas almost every year. When completed, the hydro-electric plant will supply 40,000kW from two generators to start with, and later 80,000kW from four generators.

Miscellanea

REMODELLING OF THE ESNA BARRAGE, EGYPT.—In our issue of December 24th, page 640, under the heading "Swing Bridge" in an article by R. G. G. Varden, on "Remodelling the Esna Barrage, Egypt," it was said the new bridge was "designed and supplied by Head, Wrightson and Co., Ltd." In fact, the new bridge was designed by the consulting engineers, Sir Murdoch MacDonald and Partners, and supplied by Head, Wrightson and Co., Ltd.

THE BRITISH ASSOCIATION.—Young engineers in industry are invited to submit original papers of general interest for reading before Section G (Engineering) at the meeting of the British Association for the Advancement of Science which is to be held at Newcastle-upon-Tyne in September next. Papers should not exceed 2500 words or take more than thirty minutes to read. Those desirous of contributing are asked to send a *precis* of about 100 words to Dr. H. S. Rowell, New Road, Ware, Herts, before March 31st.

PAINT ECONOMY MEMORANDUM.—The Ministry of Works announces the issue of a "Paint Economy Memorandum," which modifies and supersedes the Interim Economy Memorandum published in September, 1946. It points out that, whilst raw material shortages are less acute than in 1946, linseed oil supplies involve heavy expenditure of hard currency, and it is necessary, therefore, to continue to economise in its use, wherever possible. Copies of the new memorandum may be obtained from "Standards," Ministry of Works, Lambeth Bridge House, London, S.E.1.

EXAMINATIONS IN SALES MANAGEMENT.—The Council of the Incorporated Sales Managers' Association announces that the next examinations (qualifying and final) will be held on Thursday, Friday and Saturday, May 26th, 27th and 28th. Since 1936, the Incorporated Sales Managers' Association has conducted an examination in salesmanship, and the last examination under the existing syllabus will be held on Saturday, May 28, 1949. Entry forms and full particulars of the examinations may be obtained from the Secretary, I.S.M.A., 23, Bedford Square, London, W.C.1.

NUFFIELD FELLOWSHIP IN EXTRACTION METALLURGY.—The date for the receipt of applications for the Nuffield Foundation Research Fellowship in Extraction Metallurgy has been put forward to March 31, 1949. The Fellowship will be tenable at the Royal School of Mines, London, for a period of up to five years, and the funds available are sufficient to provide a salary of from £1200 to £1500 a year for the Fellow as well as some £2500 a year for assistants and apparatus. Applicants should have had experience in the initiation and development of research, preferably in industrial research establishments, and must put forward an outline of the research which they propose to undertake. No conditions are laid down regarding the nature of the research, provided that it is concerned with extraction metallurgy, but preference will be given to a candidate who proposes to study some problem bearing on the basic scientific principles of metal extraction. Applications, giving details of the candidate's qualifications and experience, the names of three referees and an outline programme of research, should be sent to the Secretary, the Institution of Mining and Metallurgy, Salisbury House, London, E.C.2.

BRITISH COUNCIL'S LECTURE COURSES.—The British Council has just issued a programme of approximately forty short courses which it has arranged in different parts of Great Britain for specialists from overseas. Among them are lectures on "Hydro-Electric Developments," and visits to various schemes being undertaken by the North of Scotland Hydro-Electric Board. Another course, to be held in Bristol, is entitled "The Engineer and the Municipality." It will deal with the operation and administration of the city's public utility services. Particulars of all the courses may be obtained from the British Council, 3, Hanover Street, London, W.1.

THE LATE MR. B. W. METHLEY.—We record with regret the death of Mr. Bernard W. Methley, which occurred at Rotherham on January 14th. Mr. Methley, who was seventy-two, was on the staff of Messrs. Steel, Peech and Tozer for forty-six years, and upon his retirement in 1947 from the position of chief chemist, he became a consultant to the research and development department of the parent firm, United Steel Companies, Ltd. Mr. Methley was a Past-President of the S. Yorks section of the Royal Institute of Chemistry, a Fellow of the Institution of Metallurgists, and a member of the Iron and Steel Institute and of the Sheffield Metallurgical Association.

PORTLAND CEMENT PRODUCTION.—The Cement and Concrete Association has announced that the production of Portland cement in the United Kingdom last year was 8,521,543 tons, which constituted a record, and was 3·8 per cent above the 1939 output, hitherto the highest on record. Home deliveries totalled 6,961,776 tons, which included 53,577 tons of cement imported from Germany by arrangement with the Ministry of Works, while export deliveries amounted to 1,628,200 tons, a figure 88·3 per cent above that of the preceding year. The Association points out that this record output was achieved without any additional production equipment, and that new works and extensions now in hand should lead to a further substantial increase.

CENTENARY OF RICHARD SUTCLIFFE.—January 26th marked the centenary of Richard Sutcliffe, who may be properly regarded as a pioneer in the mechanisation of the mines. He first worked coal-cutting machines in Ireland in 1876, and in 1885 he settled in the Yorkshire coalfield where he continued the development of coal-cutting machinery. In 1905, Sutcliffe invented a driving head for belt conveyors, which enabled them to be used in the confined spaces of coal mines. The first six of his belt conveyors were installed in the Glasshoughton collieries, and were 100 yards in length. The longest conveyor now installed is working at a length of 1905 yards in a Midlands colliery. The firm which Richard Sutcliffe founded, and which still bears his name, continues to operate at Wakefield.

LAYING-OUT TOOLS AND DESIGNING CAMS FOR B.S.A. AUTOMATICS.—A book recently published, at 10s. 6d. net, by B.S.A. Tools, Ltd., Marston Green, Birmingham, describes in detail and illustrates diagrammatically the full procedure which should be followed when designing cams and laying-out tools for the company's single-spindle automatic screw machines, and the calculations involved therein. Owing to the difficulty which would be encountered in setting down fixed rules to cover all aspects of cam design, the procedure adopted in a number of typical tooling lay-outs has been described in the fullest detail. The book also includes a number of charts and tables, likely to be of assistance to designers and engineers concerned with production on this type of machine.

Contracts

DURING the past month contracts have been placed by the British Electricity Authority for generating station, switching and transforming station and transmission equipment amounting in the aggregate to £2,018,902.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Association of Building Technicians

Thurs., Feb. 10th.—Caxton Hall, Westminster, S.W.1, "Modern Concrete Technique on the Job," E. H. Collier, 7 p.m.

Association of Supervising Electrical Engineers

Tues., Feb. 1st.—N.W. London Branch: St. Hilda's Hall, Northolt Road, South Harrow, discussion evening, "The Social Responsibilities of the Engineer," opened by R. F. Mathieson, 7.45 p.m.——S.E. London Branch: Castle Hotel, High Street, Eltham, competition papers night, 8 p.m.

Wed., Feb. 2nd.—N.E. London Branch: Mawneys Arms, Mawneys Road, Romford, "Protection Relays," M. P. Foley, 8 p.m.——W. London Branch: Town Hall, King Street, Hammersmith, "Some Problems of the Estimating Engineer," J. R. Parker, 7.30 p.m.——York Branch: Royal Station Hotel, York, "Electricity in Agriculture," W. Cover, 7.30 p.m.

Chemical Society

To-day, Jan. 28th.—King's College, Newcastle-upon-Tyne, "Three and Four-Membered Heterocyclic Rings," F. E. King, 5 p.m.

Thurs., Feb. 3rd.—Burlington House, Piccadilly, W.1, Johannes Nicholas Bronsted Memorial Lecture, R. P. Bell, 7 p.m.

Hull Chemical and Engineering Society

Tues., Feb. 1st.—Church Institute, Albion Street, Hull, "Scientific Progress and the Public Telephone Service," H. V. J. Harris, 7.30 p.m.

Incorporated Plant Engineers

Mon., Jan. 31st.—W. and E. Yorks. Branch.: The University, Leeds, "Non-Ferrous Metals," Mr. Irvine, 7.30 p.m.

Tues., Feb. 1st.—Cardiff Branch: Grand Hotel, Cardiff, "Welding as a Tool of Maintenance," 7.30 p.m.

Wed., Feb. 2nd.—London Branch: Royal Society of Arts, John Adam Street, Adelphi, W.C.2, "Accident Prevention," 7 p.m.

Tues., Feb. 8th.—Manchester Branch: Engineers' Club, Albert Square, Manchester, "The Duties of the Safety Officer," 7.15 p.m.

Institute of British Foundrymen

To-day, Jan. 28th.—W. Wales Section: Baldwin's Canteen, Landore Works, Swansea, "The Production of High Quality Castings," J. D. T. Yuille, 7 p.m.

Sat., Jan. 29th.—Wales and Monmouth Branch: Engineers' Institute, Cardiff, Film, "Aluminium Castings Production," 6 p.m.

Sat., Feb. 5th.—Wales and Monmouthshire Branch: Tech. College, Newport, "Steel Melting," 6.30 p.m.——West Riding of Yorks Branch, Tech. College, Bradford, "Foundry Education," H. A. MacCall, 6.30 p.m.

Wed., Feb. 9th.—Birmingham Branch, Students' Section: The University, Edmund Street, Birmingham, "Cupola Practice and Control," L. W. Bolton, 7.15 p.m.

Institute of Marine Engineers

Wed., Feb. 2nd.—City Tech. College, Cardiff, "The Combustion Turbine," J. Calderwood, 7.15 p.m.

Tues., Feb. 8th.—85, Minories, E.C.3, "Corrosion of Turbine Journals," S. E. Bowrey, 5.30 p.m; Municipal Tech. College, Sunderland, "Photo-Elasticity," J. Ward, 4 p.m.

Institute of Petroleum

Wed., Feb. 9th.—Manson House, 26, Portland Place, W.1, "Production from Condensate Reservoirs," L. C. Stevens and P. B. Boots, 5.30 p.m.

Institute of Road Transport Engineers

Wed., Feb. 2nd.—N.W. Centre: White Hart Hotel, Warrington, Lancs, "Hydraulic Transmission," G. Fraser, 7.30 p.m.

Mon., Feb., 7th.—Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, "Modern Automobile Transmissions," F. J. Everest, 7.30 p.m.

Institute of Transport

Wed., Feb. 2nd.—Leicester Group: City Transport Offices, Leicester, "Town Planning," J. Beckett, 6.15 p.m.

Thurs., Feb. 3rd.—S. Wales and Monmouthshire Section: S. Wales Institution of Engineers, Cardiff, film and address by F. H. Kidd, 7 p.m.

Mon., Feb. 7th.—Metropolitan Section: Livingstone House, Broadway, S.W.1, "Inland Waterways as Affected by the Transport Act, 1947," W. L. Ives, 6 p.m.——Sheffield Section: Victoria Station Hotel, Sheffield, "Tyres and Their Performance," J. H. Brown, 7.30 p.m.

Tues., Feb. 8th.—Yorkshire Section: Great Northern Station Hotel, Leeds, "Swiss Federal Railways," H. O. Ernst, 6.30 p.m.

Institution of Chemical Engineers

To-day, Jan. 28th.—N.W. Branch: College of Technology, Manchester, Annual General Meeting, "The Place of Heterogeneous Equilibrium in Chemical Engineering," F. A. Freeth, 3 p.m.

Institution of Civil Engineers

To-day, Jan. 28th.—Yorkshire Association: Royal Victoria Station Hotel, Sheffield, "Site Investigations, Including Boring and Other Methods of Sub-Surface Exploration," H. J. B. Harding, 7 p.m.

Tues., Feb. 1st.—Great George Street, S.W.1, "The Design and Strength of Standard Flat-Footed Rail and Fishplate Sections," A. M. Sims; "Practical Considerations in Regard to the Design of Flat-Bottomed Rail Track," N. W. Swinerton, 5.30 p.m.

Wed., Feb. 2nd.—Association of London Students: Great George Street, S.W.1, "Uses of Soil Cement Construction in Great Britain," S. B. Webb, 6 p.m.

Thurs., Feb. 3rd.—N.W. Association: Engineers' Club, Albert Square, Manchester, "Economic Survey as Applied to Civil Engineering," W. E. De Courcy Hamilton, 6.30 p.m.

Institution of Electrical Engineers

Tues., Feb. 1st.—London Students' Section: Savoy Place, Victoria Embankment, W.C.2, "Circuit Interruptions," J. R. Waters, 7 p.m.

Wed., Feb. 2nd.—Radio Section: Savoy Place, Victoria Embankment, W.C.2, "Direction-Finding Site Errors at Very High Frequencies," H. G. Hopkins and F. Horner; "Scattering of Radio Waves by Metal Wires and Sheets," F. Horner, 5.30 p.m.

Thurs., Feb. 3rd.—Ordinary meeting, Savoy Place, Victoria Embankment, W.C.2, "Tidal Power and the Severn Barrage," H. Headland, 5.30 p.m.

Mon., Feb. 7th.—Education Discussion Circle: Savoy Place, Victoria Embankment, W.C.2, discussion on "Electrical Engineering Taught to Other Than Electrical Engineers," opened by A. A. Hall and H. C. Mann, 6 p.m.——N.E. Centre: Neville Hall, Westgate Road, Newcastle-upon-Tyne, "Some Operating Experiences with High-Pressure Steam Power Plant," W. N. C. Clinch, 6.15 p.m.

Tues., Feb. 8th.—Measurement and Utilisation Section: Savoy Place, Victoria Embankment, W.C.2, "The Measurement of Light and Colour," G. T. Winch, 5.30 p.m.——N. Midlands Centre: Electricity Board, 1, Whitehall Road, Leeds, 1, "Sub-Stations, with Particular Reference to Yorkshire Practice," L. H. Fuller and C. R. Clarke, 6.30 p.m.

Institution of Engineering Inspection

Tues., Feb. 1st.—Bristol Branch: Grand Hotel, Broad Street, Bristol, "Railway Signalling," 7.30 p.m.——Coventry Branch: Tech. College, Coventry, "The Technique of Infra-Red Heating," Mr. Bates, 7.30 p.m.——Leeds Branch: Hotel Metropole, Kings Street, Leeds, "Testing Requirements of Castings," H. T. Angus, 7.30 p.m.

Wed., Feb. 2nd.—Birmingham Branch: Chamber of Commerce, 95, New Street, Birmingham, "Relationship of Inspection Department to Other Functions," W. A. Bennett, 7.30 p.m.

Thurs., Feb. 3rd.—London Branch: Royal Society of Arts, John Adam Street, Adelphi, W.C.2, "Boiler Plant: Chemical Inspection and Control," R. H. Burns, 6 p.m.

Institution of Engineers-in-Charge

Wed., Feb. 9th.—St. Bride Institute, Bride Lane, Fleet Street, E.C.4, "Malleable Iron Pipe Fittings," N. Pemberton, 6.30 p.m.

Institution of Engineers and Shipbuilders in Scotland

Tues., Feb. 8th.—39, Elmbank Crescent, Glasgow, "Flame Spraying of Metals and Plastics in Engineering and Shipbuilding," F. A. Rivett, 6.30 p.m.

Institution of Heating and Ventilating Engineers

Wed., Feb. 2nd.—E. Midlands Branch: College of Technology, The Newarke, Leicester, "Wood Refuse and Utilisation," E. H. Smith, 6.30 p.m.

Institution of Mechanical Engineers

To-day, Jan. 28th.—Storey's Gate, St. James's Park, S.W.1, "The Application of Free Jets to the Mixing of Fluids in Bulk," H. Fossett and L. E. Prosser, and "Investigations into Cyclone Dust Collectors," A. J. ter Linden, 6 p.m.

Sat., Jan. 29th.—N.E. Branch, Graduates' Section: Visit to the Woollen Mills of Paton and Baldwins, Ltd., Darlington, 10.30 a.m.

Tues., Feb. 1st.—Coventry Centre: Geisha Café, Hertford Street, Coventry, "Basic Problems in the Engineering of a Modern All-Metal Motor Body," E. S. White, 7 p.m.

Wed., Feb. 2nd.—N.W. Branch: Liverpool Engineering Society, 24, Dale Street, Liverpool, "Marine Engineering in the Royal Navy," Eng. Vice-Admiral Sir John Kingcome, 6 p.m.

Thurs., Feb. 3rd.—Midland Branch, Graduates' Section: Visit to British Thomson-Houston Company, Ltd., Rugby, 3 p.m.; E. Midlands Electricity Board Showrooms, Rugby, "Modern Steam Generators," W. C. Carter, 6.45 p.m.——Scottish Branch: Royal Tech. College, Glasgow, "Marine Engineering in the Royal Navy," Eng. Vice-Admiral Sir John Kingcome, 7.30 p.m.

Fri., Feb. 4th.—Storey's Gate, St. James's Park, S.W.1, "Marine Boiler Deterioration," I. G. Slater and N. L. Parr, 6 p.m.

Mon., Feb. 7th.—N.E. Branch: Neville Hall, Westgate Road, Newcastle-upon-Tyne, "Some Operating Experiences with High-Pressure Steam Power Plant," W. N. C. Clinch, 6 p.m.

Tues., Feb. 8th.—Automobile Division: General meeting, Storey's Gate, St. James's Park, S.W.1, "The Influence of Valve Port Design on the Volumetric Efficiency of the Compression-Ignition Engine," C. B. Dicksee, 6 p.m.——S. Wales Branch: S. Wales Institute of Engineers, Cardiff, "Marine Engineering in the Royal Navy," Eng. Vice-Admiral Sir John Kingcome, 6 p.m.

Institution of Post Office Electrical Engineers

Mon. Feb. 7th.—Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2, "Improvements in Telephone Signalling," S. Welch and C. H. J. Fleetwood, 5 p.m.

Institution of Production Engineers

Wed., Feb. 2nd.—Nottingham Section: Victoria Station Hotel, Nottingham, "Purchasing to Schedule," 7 p.m.——Preston Section: Clayton, Goodfellow and Co., Ltd., Blackburn, "Mechanical Mishaps and Their Relation to Design and Workmanship," G. E. Windeler, 7.15 p.m.

Thurs., Feb. 3rd.—Glasgow Section: Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, discussion on "Improved Production Methods and Management," 8 p.m.

Fri., Feb. 4th.—W. Wales Section: Sketty Hall, Swansea, "The Production of Steel Sheets," H. H. Stanley, 7.30 p.m.

Sat., Feb. 5th.—Yorkshire Graduates' Section: Visit to Phelon and Moore, Ltd., Cleckheaton, 10 a.m.

Tues., Feb. 8th.—Coventry Graduates' Section: Tech. College, Coventry, "Some Aspects of American Production," D. Burgess, 7.15 p.m.——Birmingham Graduates' Section: James Watt Memorial Institute, Great Charles Street, Birmingham, "Generation of Fine Finishes by Machine Techniques," P. Spear, 7 p.m.

Institution of the Rubber Industry

Wed., Feb. 9th.—West of England Section: George Hotel, Trowbridge, "Developments in Rubber and Plastics Machinery Design," J. Brown, 7.45 p.m.

Junior Institution of Engineers

Wed., Feb. 2nd.—Midland Section: James Watt Memorial Institute, Great Charles Street, Birmingham, Presidential Address, "Developments in the Design of Electricity Generating Stations," L. F. Jeffrey, 7 p.m.

Fri., Feb. 4th.—39, Victoria Street, S.W.1, film evening, "Mechanical Handling," introduced by W. G. Picton, 6.30 p.m.

Mon., Feb. 7th.—N.W. Section: 16, St. Mary's Parsonage, Manchester, "The Development and Manufacture of Machines for the Preparation of Textile Yarns," H. Whittaker, 7 p.m.

Tues., Feb. 8th.—Western Group of Members: Grand Hotel, Broad Street, Bristol, informal meeting, discussion evening, 7.30 p.m.

Manchester Association of Engineers

To-day, Jan. 28th.—Engineers' Club, Albert Square, Manchester, "Refrigeration as Applied to Food Preservation," A. B. Edwards, 6.45 p.m.

Manchester Statistical Society

To-day, Jan. 28th.—Society of Architects, 16, St. Mary's Parsonage, Deansgate, Manchester, "The Design of Some Simple Physico-Chemical Experiments," G. P. Sillitto, 6.45 p.m.

Newcomen Society

Wed., Feb. 9th.—Science Museum, South Kensington, S.W.7, "Early Railways in Derbyshire," B. Baxter, 5.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders

To-day, Jan. 28th.—Bolbeck Hall, Newcastle-upon-Tyne, 1, "Vibration Diagnosis in Marine Geared Turbines," H. G. Yates, 6.15 p.m.

Royal Institution of Chartered Surveyors

Mon., Feb. 7th.—12, Great George Street, S.W.1, further discussion on Mr. E. C. Strathon's address on "The Practical Aspects of Valuations Under Part VI of the Town and Country Planning Act, 1947," 5.30 p.m.

Society of Engineers

Mon., Feb. 7th.—Geological Society, Burlington House, Piccadilly, W.1, Presidential Address, E. S. Waddington, 5.30 p.m.

Yorkshire Technical Liaison Committee

Fri., Feb. 4th.—The University, Leeds, "Building Research Station," F. H. Lea, 7 p.m.

Personal and Business

Mr. Charles Smith has been appointed a local director of John Smith (Keighley), Ltd.

Mr. T. H. Eccles has succeeded Mr. T. A. Patterson as manager of the London office of Musgrave and Co., Ltd., 1a, Newman Street, W.1.

Dr. H. K. Whalley is relinquishing his position as head of the chemical research department at Manchester Oil Refinery, Ltd., to join Petrocarbon, Ltd.

Mr. W. A. Tookey, M.I.C.E., M.I. Mech. E., states that his sole address is now 83, Cumberland Road, Bromley, Kent (telephone, Ravensbourne 0773).

Mr. J. Morris has relinquished his appointment as works manager at the Crewe works of Rolls-Royce, Ltd., to become Director of Technical Research and Development with Sentinel (Shrewsbury), Ltd.

Dr. F. A. Fox has relinquished his appointment as deputy director of the British Welding Research Association to become deputy technical manager of H. J. Enthoven and Sons, Ltd., 15, Lime Sreet, London, E.C.3.

The Eastern and North-Eastern Regions of British Railways announce the following appointments:—Mr. F. A. Shorter, assistant to civil engineer (structures), and Mr. H. Ormiston, assistant district engineer, York.

The Western Region of British Railways announces the following appointments:—Mr. D. W. M. Wilson, assistant road motor engineer, Slough Mr. H. G. Lakeman, divisional engineer, Cardiff; Mr. F. L. Lambert, assistant divisional engineer, Newport; and Mr. G. A. Jennings, assistant divisional engineer, Neath.